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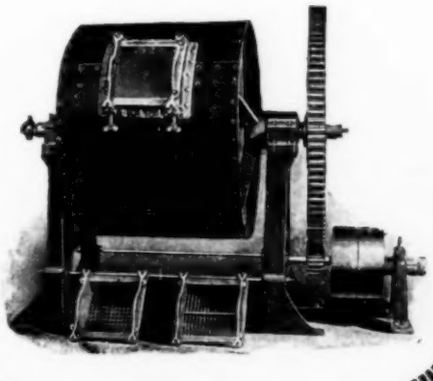

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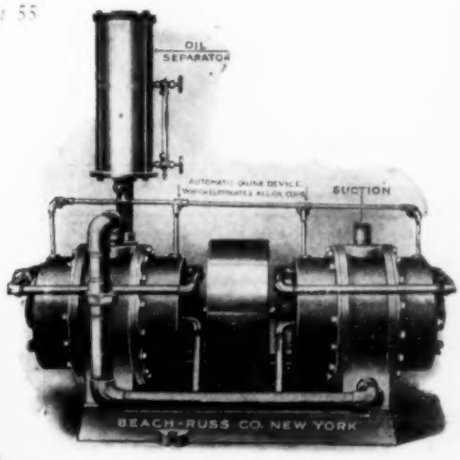

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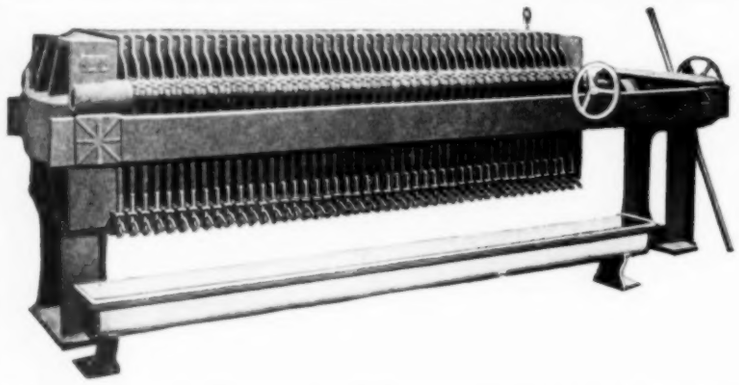

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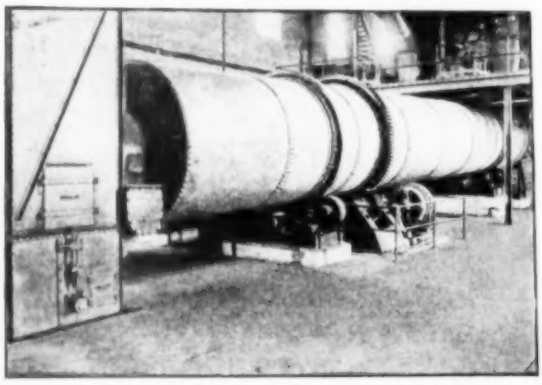

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Meetings of Chemists And Electrochemists

THE spring meetings of the American Electrochemical and American Chemical societies, which are reported in this issue, afforded the usual opportunity for discussing technical subjects, exchanging opinions and renewing acquaintances. The electrochemists, being smaller in number and more flexible in organization, adapted themselves to their surroundings at Atlantic City and indulged in competitive sports and recreation for two afternoons. Apparently this admixture of pleasure to the technical sessions was regarded as a successful experiment, because the directors voted to hold the fall meeting at Lake Placid, N. Y., September 29 and 30 and October 1. The technical feature of the Atlantic City meeting was a Symposium on Corrosion, which is fully reported elsewhere. While no new or startling facts were brought out, additional data and observations were recorded to verify or refute some of the unsettled theories which have been advanced to account for the varied phenomena of corrosion. An important action of the directors was a decision to hold a Symposium on Electrothermics annually at the spring meeting. With this topic definitely scheduled thus far in advance, it should be possible to prepare excellent programs embodying not only the results of operation but also of experiment and research. The election of ACHESON SMITH to the presidency of the society will insure a lively interest in the first symposium on this subject next spring.

The chemists met at Rochester and it is worth recording at this point that the meeting was marked by freedom from confusion and excellent arrangements on the part of the local committees. If we were to emphasize the most distinctive general feature of the convention, we should mark the presidency of Dr. EDGAR FAHS SMITH and the enlivened recognition of the need of fundamental research. Dr. SMITH is an unusual presiding officer. He speaks with such rare grace, with such sanity and good nature, that the audience hardly recognizes how closely it is held in leash. If it starts to run away from a subject, or to give way to useless discussion, he brings it back with some droll comment that does the work desired under a ripple of laughter. He adds also a quality of dignity to that of affability which is reflected in the tone of the whole meeting. The other noteworthy feature is the apparent earnest resolution of the members to declare the need of fundamental research. It presses in many places where even laboratory work in one field or another is at an *impasse* because certain facts which should be known are not available and the smaller laboratories have not the facilities to determine them. That incompetent and underdone chemists should be seeking and finding other occupations is in the nature of things and generally approved, but the disposition of short-sighted men in industry to dismantle established research laboratories in the interest of false economy is regarded as a menace to national progress.

We have no sympathy with camp-meeting designations for serious assemblies, but if we must have a tag for the occasion at Rochester we should be disposed to call it the Sober Second Thought Meeting. It was more of a scientific colloquium than a traders' assembly, and yet it would have been more illuminating to traders who have "bought into" chemical industry than any number of Chamber of Commerce festivals of speech. The necessity of real chemical scholarship in industry as well as in academic life was repeatedly emphasized, and to miss this point would have required a mind either unusually dull or supersaturated with arrogant vanity.

The general meetings were unusually constructive and informing. Senator WADSWORTH and Congressman LONGWORTH, who spoke, have a vision of the function of chemistry in national life. We cannot recall any time when such a direct, frank and confidential communication from a lawmaking body was made to the society as was presented by both these gentlemen. Certainly no political constituency could have asked or received a more direct pledge from its leader than was given to the society by Congressman LONGWORTH when he reiterated the assurance that the dye and chemical industry would be given adequate protection in the forthcoming tariff schedule.

An interesting criticism was made by Dr. ALSBERG in one of the meetings to the effect that there is too much tacit agreement at gatherings. Papers are not attacked enough. If a member gives his records and these seem wrong, somebody is likely to get up and ask the speaker how he has reached his conclusions, and the answer is not likely to contain much more information than that these were concluded from preponderance of evidence. The questioner sits down unconvinced, and the speaker is not called on to make a proper defence of his work. This has the defect of inadequate censorship, and tends to permit defective information and shallow reasoning to go on record. He intimated that we are too tender with one another, and that it is better to cause a little pain and to hurt the feelings of those who persevere in error than to permit an error to endure. We think he is right. In this respect the chemists can learn a lesson from the electrochemists, with whom the frankest criticism is the prevailing custom. Debatable and controversial questions are not handled with gloves in that organization.

We are glad to report an action by several of the sections and divisions that will have a tendency to make future meetings more interesting and profitable. It is plainly recognized that the program as now constituted is appalling rather than attractive on account of the large number of papers scheduled for presentation and the difficulty experienced by the average attendant in

discriminating between good, bad and mediocre offerings. Under the spur of Mr. HOWE'S keen criticism the Division of Industrial and Engineering Chemistry voted to appoint a committee to pass on all papers before they are accepted for the program. Papers must be in the hands of the committee at least two weeks before the meeting and they will be accepted, rejected or liberally blue-penciled according to their merits. In addition to this the chairman will decide whether papers shall be read in abstract or *in extenso* and will have power to limit discussion on subjects in which only a few are interested. Similar tendencies are noted in the Division of Physical and Inorganic Chemistry and the new Petroleum Section, both of which will issue to their members in advance of the meeting a full set of abstracts of papers admitted to the program. These are hopeful, if somewhat sporadic, signs of improvement—experiments out of which the parent society will doubtless evolve a unified plan for all sections and divisions.

A Suggestion To Authors

THIS is in the nature of a personal chat with those excellent and estimable persons who read papers at scientific society meetings. Without their zeal and enthusiasm we would have no formal technical programs, and but for their personal interest in science we would not have nearly so wide a dissemination of technical knowledge. Curiously enough, however, they frequently lack the quality of salesmanship which would greatly enhance their value to their audience. They do not know how to present the ideas which they have carefully recorded after painstaking thought, research and investigation. About twice a year following the spring and fall seasons of scientific and technical conventions, we have been tempted to express our feelings on this subject, not in unkind criticism, but by way of friendly advice and suggestion. Probably this is because it falls to the lot of editors not only to attend but also to report a great many meetings, and consequently their feelings on this subject are more intense than are those of the average attendant.

In the first place there are few technical papers that will bear reading verbatim to an audience. The literary style in which they are couched is far better adapted to quiet perusal in printed form. What the audience is most interested in may be phrased expressively, if inelegantly, by the query, "What's it all about?" In other words, there is, or should be, an important feature, result or conclusion which summarizes the author's contribution and which can be told in simple language in conversational style. It is not expecting too much of an author to ask that he shall be sufficiently familiar with his subject to be able to review and summarize his paper extemporaneously and relieve his audience of the impossible task of following him through a formal reading. This is particularly true when chemical equations, mathematical formulæ or tabulated data are to be presented. A few lantern slides and a five-minute explanatory talk will frequently tell the whole story better than a twenty-minute formal reading which leaves the audience confused. It is a matter of simple observation that the author who best transmits his ideas to his audience does so through these simple expedients; and it may be worth noting that our convictions in the matter are shared and openly expressed by those thoughtful persons trying to get the most out of their attendance on conventions.

Army's Nitrogen Policy Determined

WE NOTE with gratification that Secretary WEEKS has finally determined the nitrogen policy of the War Department and that his ruling is practically in accordance with the editorial suggestions made in CHEMICAL & METALLURGICAL ENGINEERING, April 27, 1921. The Fixed Nitrogen Research Laboratory, in American University in Washington, is to be continued, and Nitrate Plants Nos. 1 and 2, at Sheffield and Muscle Shoals, Ala., respectively, will be retained under Army control in the most economical stand-by condition. The Secretary's decision is eminently satisfactory from all points of view—fundamental scientific research, industrial development and military preparedness.

More Business In Chemistry

A YOUNG chemist who is a real one and whom we like as a companion lately criticized us technical journals for accepting the advertisement of a business institute. "Why," he asked, "do you want me to study business and salesmanship and commercial law and such things when my subject is chemistry? Being engaged in technology, I have to address myself to business problems at the expense of my information in chemistry. My proper subject for my spare time should be and is the fundamentals in science; the philosophy of the subject, the general principles, the work of THEODORE RICHARDS, or IRVING LANGMUIR, of SVEDBERG, and of the men who look ahead. Chemistry is not a dinky little thing that one studies and then *has*. No chemist is a chemist when he graduates; or at least very few are. Why should I study book-keeping when I don't want to keep books, or salesmanship when I don't want to sell? I have more important work in my own field. Chemistry is too big and too deep to make jacks of all trades of those who follow it."

Now all knowledge is not for all men nor is every advertisement in a magazine intended for every reader thereof. The place for our friend whom we quote is in the laboratory rather than in the works, and we hope to see him some day an honored professor of chemistry in an institution of learning. He has a leaning toward research in pure science, and that is where he should be engaged. But in technology we need more and better business understanding. Thorough training in and familiarity with the principles of science is the first requirement, but in technology there is an equal need of good, sound, business sense. Indeed, we can't get along without it.

The fact is we must have sense about business just as we must have sense about chemistry. When over a score of years ago the Yale Corporation promoted the greatest teacher of physiological chemistry that this country has known to be director or dean of the Sheffield Scientific School, we had a fit of indignation that has lasted until this day. Teaching is the greatest of all the arts; it is paid less, but is, in point of fact, more important than administration. The loss to medicine and biology by the withdrawal of Prof. CHITTENDEN from teaching was too great to be forgiven, even in so distinguished a body as the Corporation of Yale University. Their fault was a lack of business sense; they wanted a good administrator, Dr. CHITTENDEN was the only one they could find easily, and according to the iron-bound Yale traditions it was the only way they could provide him with the proper compensation.

Business sense means a sense of co-ordination; the ability to put the right people in the right places; the capacity to plan ahead so that the desired purpose may be achieved. It means economy in planning just as applied chemistry means economy in technology. They go together. There's every reason in the world why our chemists should have that vision of human reactions that we call business. It will help more than anything else to put an end to fake chemistry and establish chemists in the eyes of business leaders and the public.

Development Possibilities Are Unlimited

WHAT is the most hopeful fact in this period of industrial depression? Undoubtedly it is that the usual obsession has not spread that "the country is overdeveloped." That has been a dominant thought in every previous industrial depression. Each business man, reasoning from the phenomena in his own industry, has concluded that he had too many competitors. There were too many miles of railroad, and too many factories making this thing or that. Machinery had been built to do all the work and all the machine shops could hope for was employment in keeping up the machinery already supplied. That is not the common thought today.

They say human nature does not change, and that may be true in a sense, but the style of thought and the viewpoint do change. Somewhat over a century ago the crowd jeered at ROBERT FULTON because his new steamboat broke down. Today a typical American crowd would be sorry. The female of the species has been offered more in the small electric motor than the male, as an individual. She has her electric-driven vacuum machine, washing machine, wringer and ironer. The male has his electric fan in the office, and that is about all. The male's lawn mower is food-propelled, depending on weight for traction, with the coefficient of traction varying inversely with the cutability of the grass. If a lawn mower with an electric-driven cutter is put on the market the first users will not be jeered by their neighbors. The neighbors will ask, "Where do you get those things?"

Repeatedly it has been proved that the country cannot be overdeveloped and at last men have learned the lesson, partly at least, supplied by recorded history. At a given time there may be too much of a material offered, or too many of a given device, for the people to buy, but that is because they have not been working hard enough or have not utilized other economical materials or devices to enable them to save the necessary money. That is what men do in every industrial depression or in its latter part.

The obsession that "the country is overdeveloped" did not make its appearance with recent industrial depressions, but has been chronic for three-quarters of a century, or since the introduction of farm machinery released a large percentage of the population from agriculture to engage in manufacturing. Each time, when the depression ended, it was seen that the country was not developed too much, but that instead it had fresh possibilities. What occurred was that prices and costs went too high and people became disinclined to buy. As the people curtailed their purchases they produced a condition that enlarged the prospect of prices and costs going lower and thus the tendency to abstain from buying was encouraged, the influence being cumulative, until the shake-out became sufficient to justify making a fresh start.

To-day one does not hear the cry, to any extent, that "the country is overdeveloped." Instead, people are simply saying prices are too high, wages are too high, costs are too high, and when they find their proper level business will go forward. Public thought has not, as a millstone around its neck, the notion that everything worth doing has already been done and there is little left for the future to do.

Men will be quite ready to take hold when the readjustment in prices, wages, costs, has been completed. They are anxious to take hold. They are not afraid that the work has already been done. Anyone can see ample prospects of work and development. Under proper financial and industrial conditions we can profitably electrify our railroads, stop the consumption of over 90 per cent of our bituminous coal without recovery of byproducts and the movement of hundreds of millions of tons of coal a year over railroads (when the high-tension electric line is a vastly greater improvement in transportation than was the oil pipe line of nearly half a century ago), reduce the air, noise and heat leaks in our dwelling places and do a thousand other things, not forgetting to provide the electric-driven grass cutter already mentioned. The public has sensed the situation rightly. The country is not overdeveloped; it merely needs to readjust some things.

Interim Protection For the Dye Industry

IT HAS BEEN a matter of some speculation and no small degree of anxiety to foresee how the dumping of dyes in this country could be prevented in the interim between the declaration of peace with Germany and the passage of tariff legislation. The first proposal was to attach an amendment to the Knox peace resolution, extending the powers of the War Trade Board Section of the Department of State, which now regulates imports of dyes from Germany. This possibility, however, was eliminated when all amendments to the Knox resolution were rejected.

A much more hopeful prospect for quick and effective action, however, is seen in the proposal to handle this matter in the emergency tariff legislation. The Senate Committee on Finance is now considering an amendment to H.R. 2435, excluding from importation into the United States for a period of six months from the enactment of the legislation, sodium nitrite, coal-tar products and synthetic organic drugs and chemicals, unless the Secretary of the Treasury shall determine that such articles or satisfactory substitutes are not obtainable in the United States in sufficient quantities and on reasonable terms. In this event the prohibited articles may be admitted for consumption by an actual consumer in the United States within six months after receipt of the merchandise. The amendment further provides for the transfer of the personnel, records and activities of the War Trade Board Section of the Department of State to the Department of the Treasury.

Emergency tariff legislation is not regarded seriously in many quarters, being looked upon as a political sop to agricultural interests. Apparently, however, it may become the most handy medium for accomplishing interim protection to the dye industry. It's an ill wind that blows nobody good.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, April 14, 1921.

THE industrial and political situation completely dominates markets at the time of writing and even if, as is confidently predicted, the threatened railway and transport strike should be canceled, the recent revival has already been stopped and a considerable period will be required for recovery.

REPARATION ACT FAILS TO BENEFIT PURCHASERS OF CHEMICALS

The reparations bill has apparently not yet produced any "reparations" as far as the chemical trade is concerned. As foreshadowed in my last article, German exporters are demanding either payment in full, leaving the British importer to pay an equal amount in duty, or alternatively simply doubling their prices. In either case the consumer ultimately has to pay the tax, and it is becoming a question of whether the loss of trade will be sufficient to force Germany to make fresh proposals. Meanwhile the stocks of German chemicals imported or under contract prior to March 8 are fairly heavy, and some weeks must elapse before any appreciable rise in prices is to be expected.

FINE CHEMICALS INCLUDED IN PROTECTIVE MEASURE FOR KEY INDUSTRIES

In addition to optical and chemical glassware, tungsten, thorium, cerium, etc., the new "ways and means resolutions" to be discussed before inclusion in the finance act include "all synthetic organic chemicals (other than the dyes, etc., protected under the dyestuffs bill), analytical reagents, all other fine chemicals and chemicals manufactured by fermentation processes." Protection is to be given in the form of 33⅓ per cent customs duty for five years, and there is to be a similar duty in respect of "dumped" goods or those which are, owing to depreciated currency, offered at prices below the cost of profitable manufacture in the United Kingdom. The introduction of this legislation was unavoidably postponed by the industrial crisis, but already claims for the protection of other industries and goods and protests against the inclusion of others are being pressed on the government and on members of Parliament. It is understood that among others metallic magnesium is likely to be included, and that the fiercest controversy will develop in regard to the alleged inadequacy of the protection afforded. Meanwhile the fine chemical industry remains stagnant, many works being closed down or working on half time, while others are finding difficulty in raising further capital.

BRITISH DYESTUFFS CORPORATION DISMISSES ITS MANAGING DIRECTORS

Something of a sensation was caused by the announcement made at the annual meeting of the British Dyestuffs Corporation that the board of directors had decided to terminate the agreements with Sir Joseph Turner, who controlled the Huddersfield Works, and Dr. Herbert Levinstein. Although rumor had been rife in regard to Dr. Levinstein's retirement and in regard to lack of harmony and co-operation, the drastic steps now taken were quite unexpected. The board announced that pending unification of control under a single managing director a committee of three directors would form the executive, but it remains to be seen whether a suitable "superman" will be forthcoming. Sir Harry McGowan, of Nobel Industries, retired from the board earlier in the year and the new directors appointed are Field Marshal Sir William Robertson, Sir William Alexander (formerly of Charles Tennant & Co.) and Vernon Clay, chairman of the Color Users Association. There is likely to be further controversy before the affairs of the corporation recover from what is considered to be an unnecesasry muddle. Meanwhile the dyestuffs position remains practically unchanged and Sir H. V. Kilvert, a prominent member of the Manchester Chamber of Commerce, has been appointed chairman of the advisory committe under the dyestuffs act. There has been further delay in the appointment of the development committee.

BRUNNER, MOND TO INCREASE CAPITAL

It is announced that in addition to making suitable alterations in the articles of association of Brunner, Mond & Co. $10,000,000 of additional 7½ per cent preference shares are to be issued in the near future. Work at Billingham synthetic ammonia factory is making good progress and part of the capital issue is no doubt required for that purpose. On the other hand Magadi soda shipments have begun, so that details of the prospectus are awaited with great interest. Wages of chemical workers are being reduced by many works, notably by Lever Bros. and the United Alkali Co., and owing to the depressed state of markets and the fall in the cost of living this tendency is likely to continue.

GENERAL NOTES

The report of the commission under General Hartley which visited German chemical factories last year is to be published at an early date and, unlike the corresponding report of the mission fathered by the Association of British Chemical Manufacturers, will be available to the general public. Like the report of the nitrogen committee, publication has been delayed so long that much of the matter will be out of date. Further details of the visit to Canada and the United States of the Society of Chemical Industry will shortly be available. It was felt that if possible the whole party should travel together on a "one-class" boat and fortunately the cancellation of the sailing of the Megantic will probably enable the president to sail with the rest of the party on the Melita on Aug. 12 for Montreal. It was hoped that the larger firms would send special representatives, but so far the response from this quarter has been very feeble, though it is perhaps too soon to judge of the final result. It now seems unlikely that the party will number more than sixty. Circulars have just been sent to all members of the engineering profession with regard to the proposed formation of an engineers' club with headquarters in St. James' St. It is stated that over 1,000 engineers have signified their intention of joining the new club, the subscription for which has been fixed provisionally at $40 for town members. The promoters are seeking to include chemical engineers and others connected with the chemical industry, but it is felt that on account of the relatively high subscription the club will not be truly representative and is not likely to include the junior members of the profession. Sir William Pope is to address the members of the Chemical Industry Club next month and will probably deal with the further development of the scheme for central premises promoted by the Federal Council of Pure and Applied Chemistry.

Meeting of the American Electrochemical Society

Report of the Spring Meeting, April 21-23, 1921, at Atlantic City, N. J.—Business Session—Presidential Address—Summaries of the Technical Papers Presented, With Discussion of These Papers—Social Features

THE thirty-ninth General Meeting of the American Electrochemical Society took place at the Hotel Chalfonte, Atlantic City, April 21 to 23. The meeting was exceptionally well attended and was conceded by all to have been one of the most interesting and enjoyable held by the society. There were a number of papers that drew forth much heated discussion. The social functions, favored by ideal weather, afforded the members a splendid opportunity to renew old friendships and increase their acquaintanceship. Much of the success of the meeting is due to the able guidance of the committee of Philadelphia members.

Business Sessions of the Society

At the meeting of the board of directors, Thursday evening, various matters of importance were discussed. The place of meeting in the fall was definitely fixed as Lake Placid, N. Y., Sept. 28 to Oct. 1 inclusive. An invitation was read to meet in Buffalo in the spring of 1922, but no final action was taken. The board sanctioned the formation of a Division on Electrothermics which will include all those members interested in electric furnaces, electric steel, electric brass, etc., electrodes, refractories, regulators, heat-treating apparatus, etc. Acheson Smith is chairman of the new division. President Landis appointed a committee of three, William Blum, George B. Hogaboom and H. S. Lukens, to canvass the membership of the society and ascertain whether a division on electrodeposition would meet with the necessary support and encouragement. The division, as proposed, is to cover the subjects of electrolytic refining, electroplating, electrotyping and electro etching.

At the annual business meeting on Friday morning the following new officers were elected: President, Acheson Smith; vice-presidents, Charles F. Burgess, C. G. Schluederberg and E. L. Crosby; managers, Carl Hering, J. V. N. Dorr, F. A. J. FitzGerald; treasurer, P. G. Salom; secretary, Joseph W. Richards. The treasurer's report for the term 1920-21 showed total assets, $13,100; total receipts, $24,000, and total expenditures $28,134, of which $19,730 covered the publication of four volumes of the *Transactions*.

In the absence of Dr. Baekeland Mr. Hamilton, examiner of the U. S. Patent Office, reported briefly on the present status of the patent bills before Congress. He emphasized that the Patent Office was flooded with applications and that work was proceeding very slowly and inefficiently, due to lack of proper financial support and encouragement for the employees to remain in office. Mr. Hamilton also urged the members present to exert their influence in encouraging the teaching of electrochemistry in schools and colleges.

The publication committee's report was presented by Dr. Fink. It was decided to hold a session on Non-Ferrous Electrometallurgy and another session on Electrodeposition at the coming fall meeting of the society at Lake Placid. At the spring meeting, 1922, there will be a session devoted to Electric Furnace Cast Iron. For future meetings, Dr. C. W. Moore suggested a symposium on "Electromotive Force" and E. O. Benjamin suggested a symposium on the production and utilization of "Electrolytic Gases" such as hydrogen, oxygen and chlorine.

At the conclusion of the business meeting a number of amendments to the constitution were voted. According to one of these amendments a quorum of the society shall henceforth consist of fifty members instead of 10 per cent of the membership, now totaling 2,300. Another amendment authorizes the board to appoint an assistant secretary who shall relieve the secretary of all clerical work. A new section was added to the constitution providing for a nominating committee.

At the conclusion of the business meeting the retiring president, Dr. W. S. Landis, delivered a highly interesting and instructive address entitled "Our Inventory."

Presidential Address—Our Inventory

BY W. S. LANDIS

At long and irregular intervals it was the habit of the proprietor of the crossroads general store to walk slowly through his place of business, glance to the right and to the left, and up and down, and make mental notes on the status of his stocks. So long as this crude method of determining his inventory was satisfactory to himself he remained the country storekeeper or fell by the

wayside. If through accident he developed to the stage of actually "taking stock," he abandoned the country store, moved to the nearest town and opened up a larger and more elaborate, though frequently more specialized, place of business.

There is a wide difference between the primitive stock-taking of the crossroads merchant and the continuous inventory carried by our modern corporation, and we of the newer school are still theorizing as to the ways and means which keep some of the old timers in the field. At the same time when we look into our own branch of industrial activity, I think we will find its system of inventory is in much the same condition as that of the crossroads store. Are we carrying such a form of inventory as to enable the quick determination of the quantity and quality of stocks on our shelves? Is this stock suited to our markets? Will we be able to meet our competitors on their own terms? How much do we know of the future prospects of our business? Remember, I am speaking here of the industry as a whole and not of any specific branch or unit.

Magnitude of the Electrochemical Industry

The industry with which we as members of this Society are associated—that one utilizing the chemical and thermic effects of the electric current—represents, on the North American continent, an invested capital of something over six hundred million dollars. As a matter of fact this may actually be upward of a billion dollars, but our antiquated crossroads system of keeping our inventory does not permit us any great degree of precise determination of such factors. The lesser figure does not include, so far as it has been possible to segregate the same, those portions of plants not exclusively a part of the electrochemical process, nor does it include generating stations where they are operated as separate corporations. The great difficulty, however, has been to determine where the line should be drawn in those industries which use the same equipment for products derived from electrochemical or electrothermic sources, and from other sources independent of the electric current. It is this indefiniteness that represents the difference between the six hundred million dollars and the billion dollars mentioned above.

The casting of a balance sheet of an industrial group the size of ours is a somewhat different task from merely keeping up the inventory of an individual unit making a part of the whole. We are dealing with factors here as fundamental items which are usually only considered from the unit standpoint as intangibles.

My attempt at compilation will fall far short of the desired completeness we all desire, but matters of this sort and in this place can always be passed on to one's successors.

Location

Our first item of consideration is the value of the location we have chosen to establish our industry. It is not unusual to hear, for example, that Norway is the logical home of the electrochemical industry, or that Germany will stifle all future competition in our line. Are we to consider, on the basis of such broad and unsupported statements, that our choice of location has been an unfortunate one—that we are located on a side-street in a poor neighborhood—that America is a liability to us instead of an asset? Personally I have no time for such propaganda—I am not even disturbed by the fact that a prominent American corporation has established a Norwegian branch factory. The mere fact that Norway seems to have an abundance of undeveloped water power will not make it the Mecca of the electrochemist, for it takes more than undeveloped water power to build up an industry such as ours, and when one considers that Norway possesses no local markets, must import every pound of coal and coke, is short of skilled labor and uncertain as to temperament of the little unskilled labor available, I am not ready to write off very much on our choice of location.

In appraising the value of location, one must consider many factors, for example: The liberal form of government under which we live for a time showed a decided tendency toward an unfortunate socialistic attitude to industry. This now appears to have been only an incident of the war and prospects ahead of us are that we shall soon be clear and free to develop in proper competitive and individualistic manner. Laws governing proper combinations for meeting foreign competition are becoming more constructive and helpful. Outside of England I do not believe a single European nation can today compare in as liberal prospective legislative helpfulness.

Transportation

As to transportation, the war left us a great fleet of merchant ships capable of taking adequate care of our export business. Unfortunately operation of this fleet is handicapped by marine laws framed by prairie sailors. Some day our scheme of government may advance to that state of development where political expediency makes way for skill and experience in the proper planning of specialized activities. Improvement of inland navigation in many cases goes hand in hand with hydro-electric development, all of which will help to unload our railroad systems. The electrochemical industries should be the preferred customers of such inland water transportation systems because of their location.

Our railroad system is the best in the world, even in spite of the universal domestic criticism. Just ask any returning foreign traveler. But development is at a standstill, rates are impossible; in fact in this case "best in the world" really means everything is pretty poor. The railroads are in for a complete reorganization—new management, new policy, greater efficiency from fewer and better employees—and they had better start pretty soon and get it over with or industry will again be on their heels.

Water Power

The recent water-power legislation will certainly lead to several important new hydro-electric developments and the possible establishment of new electrochemical centers. When prices of construction materials and labor drop to a point when the fixed charges imposed on the power cost are not too burdensome, work will begin on the many long-delayed projects. Our industry is bound to profit through these undertakings.

Fuel

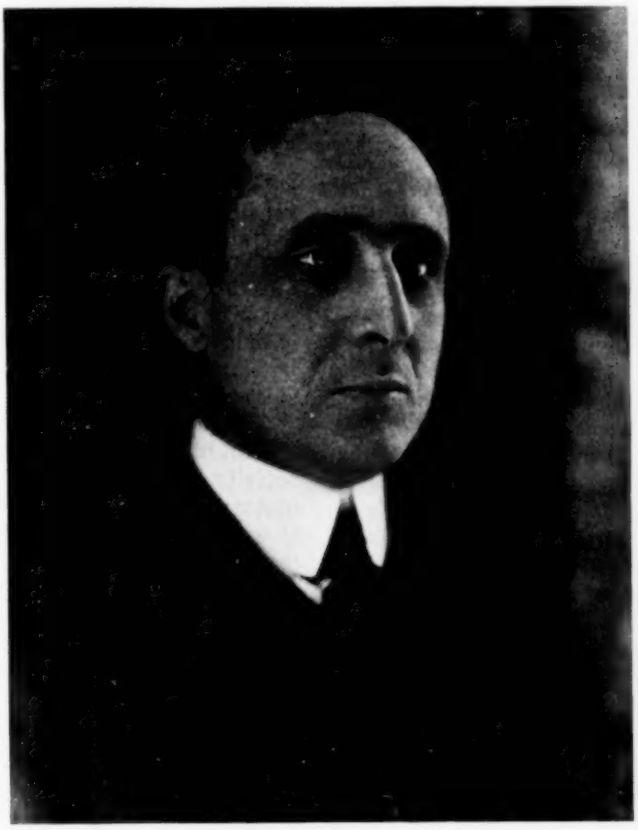
Someone has said that electricity in electrochemistry is merely an excuse for burning coal. When one looks over the fuel requirements of the heavier electrothermic industries, the statement is not a great exaggeration. Nowhere outside of the United States is there already developed the abundance of high-grade fuel that we have near our electrochemical centers. Continental

fuels are of inferior grade and higher in price. Even English coals are going to be expensive in the future. Of the materials for making electrodes, we have in plenty and of such quality that today our large carbons command first place throughout the world.

Raw Materials

It is no doubt true there are a few raw materials used in this industry with which we are not abundantly supplied. During the war emergency special efforts were made to develop the production of these miscellaneous materials, and the efforts were crowned with some success. If a fraction of the great sums of money spent on war plants which were of absolutely no use whatever toward the winning of the war—and I am not including here many plants founded upon perfectly sound engineering judgment and certain of performance but not completed before the signing of the armistice—had been spent on the search and development of some of our less plentiful raw materials, I might have a different story to tell with respect to these less abundant materials.

I believe after due consideration of the few facts just stated that we can write our choice of location down on the asset side of our balance sheet and give it a very high value. On the other hand there is no doubt that we must place against this large asset a small liability for shortage of a few rare materials and a larger liability for the disorganized state of our transportation systems. But so far the assets greatly exceed the liabilities, which foreign propagandists will please note.



ACHESON SMITH
Newly Elected President of the American Electrochemical Society

The chemical industry of this country is comparatively new. We did not possess the background of alchemists that Europe had, but we seem to be fast making them. Our schools of chemistry have only in the last few years taken on a semblance of Americanization, for most of our older teachers were educated abroad and equipped their laboratories almost exclusively with foreign apparatus. This has not been altogether satisfactory, for our industry is primarily an American one using American processes worked in American apparatus, and supervised by American engineers. Aluminum, carbide, graphite, metallic sodium and a host of other products are primarily of American origin. The caustic soda and chlorine industries use almost exclusively American cells. As a matter of fact I do not know of anything in the industry of any great importance that has been brought over from Europe and held to its original European form for any length of time, and I know of only one considerable development in Europe that seems not to have been brought here at all. With these facts in mind, we must agree that the American engineer is superior to the European in all electrochemical and electrothermic development, in spite of his semi-European chemical training. It is our duty to impress these facts upon the direction of our schools of higher education and render all the assistance we can to Americanize their methods and equipment.

Our industry with six hundred million to one billion dollars of capital investment looks for a profit of from one hundred to two hundred million dollars annually to meet capital charges and provide for reasonable growth and development. This return must come from the direct efforts of those charged with the conduct of the business—the executives, superintendents, engineers, etc. In other words men largely technically trained are responsible for the earning of this enormous sum of money, and the universities and technical schools must in turn supply these men. Looking at this from a "gross" standpoint, the electrochemical industries must return approximately five hundred million dollars per annum, largely via university products.

Only a few technical schools make direct attempts at turning out electrochemists. Some others merely provide auxiliary courses in electrochemistry, and a still larger number merely group the subject with physical chemistry. There are practically no schools capable of properly handling post-graduate students in electrochemistry, because they do not have the necessary equipment.

In our schools of civil engineering we give our men regular drafting equipment. They work with standard levels and transits, and do not use small-scale model testing machines in their study of materials. In our schools of mechanical engineering we provide our men with regular boiler plants and operating steam engines, not models. The students are not forced to work with miniature automobiles or internal combustion engines in any laboratories with which I am familiar. Why, therefore, should we expect in the training of our electrochemists that they should do their work in the laboratory entirely with glass beakers or similar small-scale equipment?

Why should the only representative electric furnace with which they ever come in contact during undergraduate days be either a picture or a small model, or in a few particularly fortunate cases exist in some nearby industrial plant that is open to their general inspection? If we are going to really educate electrochemists, we must provide in the university as a part of the daily working equipment, not models, but actual

industrial installations, and operate these before and with the student through the assistance of practical electrochemists, supplementary to the theoretical instruction and lecture work.

I very much doubt if the universities of this country have available and are spending $100,000 per year for the direct teaching of electrochemistry. I do not know of a single school laboratory that has a thousand kilowatts available for electric furnace work, or more than a model plating or refining equipment. If the industry is going to expect the graduates of institutions operating under such handicaps to return to it a gross of some five hundred million dollars per year and a net of from one hundred to two hundred million dollars, it will have to do something for our educational institutions along electrochemical lines, otherwise the German threat may not be all propaganda.

This Society holds two meetings a year, and averages nearly a thousand pages of publications annually. Our system of keeping inventory does not permit us to determine just what net returns the industry obtains from the communications, meetings and other services rendered by the American Electrochemical Society. It is my opinion that it adds directly a good many thousand dollars per year toward the net of the corporations. I am certain that if we include the dues of members paid by the corporations, the corporations will not have contributed $2,500 per year to the support of the Society, an extremely small percentage of the net return they derive from the existence of just such a body at this.

The Society is doing the best it can and to the extent of its available means to advance the interests of electrochemistry. With larger means it could do a great deal more. The officers of the Society believe that it would be unwise to attempt to raise additional funds by increase of dues. There is, therefore, only one way to obtain the greatly needed additional income which the Society could profitably use and that is through some working arrangement with industry whereby additional funds could be secured on something other than a charity basis. Since I am merely casting up an inventory which is presumed to be a record of facts and not of opinions, I merely wish to leave this idea with my successors with the hope that they can work something out of it.

Labor

As to the ordinary labor in our plants, I am not prepared to say that it is of as high quality as might be found in other countries, but at the same time I will not class it lower. On the other hand, we use only a fraction of the quantity in this country that is used abroad. We use automatic devices much more freely. We build larger units and operate them at higher capacities. In consequence while our common labor may not be quite so steady and is not so cheap per man-hour, when we consider the quantity used I do not believe that labor places an extremely serious handicap on the development of the American industry.

There are many labor abuses which will have to be corrected. The demoralization incident to the war is already being eliminated and it will probably not be long until our labor cost will not be the determining factor in foreign competition.

Reviewing our item of personnel, I think we can list the engineering ability, inventiveness and efficiency of the American engineer and the American workman as an asset of particularly high value. I cannot place the technical school and the Society on the other side of the balance sheet, because that would put them in the false light of being liabilities, when as a matter of fact we know they are not, and have been rendering wonderful service under existing handicaps, but at the same time I think we must all admit that they are not up to the standard we are desirous of setting for such institutions and that our first endeavor in rectifying this inventory should be directed to improving those two items.

I could continue in this manner to discuss many additional items, such as our research and technical organizations, periodicals, our prospective future developments, and a host of others; they all call for attention which time forbids my yielding. I am certain all will fall in with our assets.

Conclusions

Close scrutiny of our balance sheet shows our industry to be in excellent condition. Every such report I have ever seen of a going concern always has a liability side and we are no exception. General business conditions at this time are not good. Low exchange values of foreign coins, coupled with questionable economic practices in some of the European countries, are causes of temporary but immediate concern. Bad habits acquired by our legislative bodies during the war and not yet broken will trouble us for some time. The relationship of our schools and this Society to the industry can be improved. All must be properly weighed and considered.

On the other hand, the wonderful opportunities America affords for the development of our industry, the skill, activity and courage of our engineers, all against the historical background set up by Acheson, Castner, Cowles, Hall and a host of other early workers, can mean only the most successful future. Let us take full advantage of the opportunity.

Technical Sessions

There were three technical sessions, one on "Arc Welding and Electric Furnaces," another on "Electrolytic Products and Cells" and a third on "Corrosion." In addition to these there was a public address by Dr. R. B. Moore on "Helium." Brief accounts of the papers presented at the various sessions, together with the discussions, are given below. The Symposium on Corrosion is treated collectively in a separate article. Corrosion is a topic of ever-increasing importance and many of the authorities on the subject attended the symposium.

Helium and Other Rare Gases

A most enjoyable and instructive lecture on his experience and research with the rare gases of the atmosphere was delivered before the members of the Society Thursday evening by Dr. R. B. Moore of the U. S. Bureau of Mines. With the aid of numerous lantern slides and practical demonstrations Dr. Moore sketched the history of the rare inert gases, referring to the work of Cavendish, Lord Rayleigh, Sir William Ramsay and others. He described the three important processes for separating helium from other gases: The Claude, the Linde and the Jefferies-Norton. The capacity of the new plant at Fort Worth, Tex., is 35,000 to 40,000 cu.ft. of helium per day. The lifting power of helium is 92 per cent of hydrogen. The cost of helium

by the Jefferies-Norton process is about $30 per 1,000 cu.ft.

Arc Welding and Electric Furnaces

O. H. Escholz, research engineer of the Westinghouse Co., East Pittsburgh, presented a study of the Phenomena of Arc Welding. Vaporization and condensation of electrode material cannot account for all the metal transfer, since the energy input is insufficient to vaporize metal at the rate it is consumed. In fact 60 per cent of the energy is probably absorbed in liquefying 90 per cent of the wire electrode, 25 per cent in vaporizing the remainder, leaving 15 per cent for radiation losses. Expansion of gases occluded in the welding wire undoubtedly occurs, but this is not the cause of extensive transfer of metal, because "gassy" wires do not deposit at high rates; in fact quite the opposite. Escholz therefore holds that the electrode metal is transported when gravitational force exceeds the sum of surface tension and cohesion in a globule of liquid, or when physical contact is made with a wetted surface (plate metal liquefied by anode energy).

In the discussion of Mr. Escholz' paper C. J. Holslag, of Newark, did not believe that magnetic effects were very pronounced in arc welding. It was his experience that the metal passes from the electrode to the work as a vapor. The heat generated at any instant in a particle of metal at the tip of the electrode is transferred in the next instant to the work. This accounts for the high temperature of the work. Henry Hess, of Philadelphia, suggested that it would be interesting to determine the speed of metal deposition by the arc.

Electric Furnaces for Non-Ferrous Metals

H. W. Gillett of the U. S. Bureau of Mines gave the next paper, on "Electric Furnaces for Non-Ferrous Metals." This paper contains many details on the electric furnaces in operation in the United States melting non-ferrous metals. Makes and capacities are summarized in Table I, and the applicability of various types of furnaces to common alloys is noted in Table II.

Non-ferrous electrometallurgy has made wonderful strides within the last five years and the electric furnace has been firmly established in the brass and bronze industries. At the coming Lake Placid meeting a whole session will be devoted to the subject.

TABLE I. SUMMARY OF ELECTRIC FURNACES

Make	Total Capacity per Heat, Tons	Total Kw.	Number Furnaces	Number Users
Ajax-Wyatt	45	4,635	93	25
Detroit Rocking	53	15,900	57	28
Baily	48	6,890	76	51
Booth	13	5,345	40	35
13 other furnaces	34	9,580	52	30
Total in use	193	42,350	318	169
Ajax-Wyatt, planned for prompt installation	(35)	(4,200)	(70)	25 duplicates
Total, including Ajax-Wyatts planned	228	46,550	388	144 separate users

Electrodynamic Forces in Electric Furnaces

Dr. Carl Hering of Philadelphia, in his paper on "The Electrodynamic Forces in Electric Furnaces," described in detail the various "effects" met with in the operation of electric furnaces. Conductors carrying large currents are surrounded by a magnetic field exerting a strong force perpendicular to the surface. If the conductor is a liquid—as in some channeled electric furnaces—the current and its accompanying radial compression may cause the conductor to part; the phenomenon has been long known as the pinch effect. A complementary force is the so-called "stretch" effect, which tends to lengthen a conductor and causes a liquid conductor to move along its axis or heap up on the outside of a turn. Furthermore, strong eddy currents are set up in a liquid conductor on the outside of a square corner; "corner" or "motor" effect. All these circuits tend to produce motion which sets up a counter e.m.f., an observation thought to have the generality of a law.

G. H. Clamer of the Ajax Metal Co. took exception to a number of the statements made by Dr. Hering. He referred to the early work of Schneider, president

TABLE II. APPLICABILITY OF VARIOUS TYPES OF ELECTRIC FURNACE TO VARIOUS ALLOYS

Alloy Analysis									Types of Furnaces						
Fe	Cr	Ni	Cu	Sn	Pb	Zn	Ag	Al	Direct Arc	Stationary Indirect Arc	Moving Indirect Arc	Reflected Heat	Contact Resistance (Bennett)	Vertical Ring Induction	High Frequency
..	15	85	..	..	..	..	..	..	O.K.	O. K.	O.K.?	?[1]	?	?	O. K.?
5	..	67	28	..	..	..	..	..	O.K.	O. K.	O. K.	?[1]	?	?	O. K.?
..	..	25	75	..	..	..	..	..	?[2]	O. K.	O. K.	O. K.	O. K.?	?	O. K.?
..	..	5	95	..	..	..	..	..							
..	..	..	100	..	..	..	..	..	?[2]	O. K.	O. K.	O. K.	O. K.	No[3]	O. K.
..	..	90	10	..	..	..	..	..	O. K.	O. K.	O. K.	O. K.	O. K.?	?[3]	O. K.
..	..	88	10	..	2	..	..	..							
..	..	80	10	10	..	..	..	..	O. K.[5]	O. K.	O. K.	O. K.	O. K.?	No[4]	O. K.
..	..	76	3	18	3	..	..	..							
..	..	68	4	26	2	..	..	..							
..	..	..	85	5	5	5	..	..	No[5]	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.
..	..	..	74	4	5	17	..	..	No[5]	No[5]	O. K.	O. K.	O. K.	O. K.	O. K.
..	..	..	80	..	..	20	..	..							
..	..	..	70	..	..	30	..	..							
..	..	..	67	..	3	30	..	..							
..	..	..	61	1	..	38	..	..							
..	..	..	65	..	1	34	..	..							
..	..	..	60	..	..	40	..	..							
..	..	18	58	..	..	24	..	..	No[5]	No[5]	O. K.	O. K.	?	O. K.	O. K.
..	..	..	3	..	..	15	..	85	No[5]	?[5]	O. K.	O. K.	?	?[3]	O. K.
..	..	..	2	..	..	30	..	68							
..	..	..	8	..	..	..	..	92	?	O. K.?	O. K.	O. K.	?	?[3]	O. K.
..	..	..	10	..	..	..	90	..	?	O. K.	O. K.?	O. K.?	?	?[3]	O. K.
..	..	..	10	..	..	85	..	5	No	No[5]	O. K.?	O. K.	?	?	O. K.?

O.K. = Furnace metallurgically satisfactory for this alloy.
? = No data on hand.
O.K.? = Probably satisfactory, but no record of trial.
No = Furnace not satisfactory for this alloy.

[1] Temperatures probably rather high for good refractory life.
[2] Question of copper poisoning by fume from direct arc not yet settled.
[3] Induction furnace on this alloy would require resistor tube of special design.
[4] Lead too high for good life of usual lining of induction furnace.
[5] Furnace causes loss of volatile metal from this alloy.

of the Creusot Steel Works, France, and to his furnace with a liquid resistor outside the bath. In the Ajax-Wyatt furnace the pinch effect is not the sole factor. Its successful operation is based upon a combination of the pinch effect and the motor effect. The motor effect is caused "by the repulsive action of two conductors carrying unlike currents, thus causing the particles of metal in the conductors to be repulsed as far away from each other as possible."

Recent Progress in High-Frequency Inductive Heating

"Recent Progress in High-Frequency Inductive Heating" was the title of Dr. E. F. Northrup's paper, a sequel to that presented before the Society in April, 1919. His new paper was received with great applause and very favorably commented upon. It will be published in full in a future issue. In discussing his own paper Dr. Northrup pointed out that so far only the "star" connection was found to be practical when using this style of furnace on a commercial three-phase circuit; the "delta" connection does not work properly. He recently melted a fairly large quantity of a very high melting alloy composed of tungsten, osmium and a little nickel; he has also melted a sample of pure tungsten in his furnace. Dr. Northrup described in detail the building up of the inner lining of his carbon or graphite crucible. This lining will withstand a temperature of 2,000 deg. C. and is practically impervious to gases at this temperature.

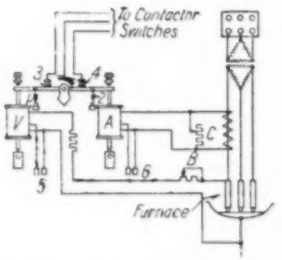
Dr. Northrup said that he had found lampblack to be the best heat insulator at high temperatures. Graphitization of carbon is carried out so readily in the high-frequency furnaces it is probable that this may become one of the main uses for the furnaces. By imbedding a compressed piece of carbon in lampblack the graphitization can be carried out very easily. Similarly, a pure rod of cobalt can be produced by introducing into the Northrup furnace a compressed rod of cobalt powder packed into very finely divided and loosely packed cobalt powder. The metal rod so made will be practically free from carbon.

Mr. FitzGerald of Niagara Falls referred to some of his experiments years ago on the graphitization of carbon, stating that he had encountered all kinds of difficulties in keeping large pieces of carbon from cracking. Would this difficulty be easily surmounted when graphitizing in the Northrup furnace? Dr. Fink pointed out that the success of a crucible lining such as Dr. Northrup described was largely a matter of grading the layers so as to pass, step by step, from a low coefficient of expansion to a higher one. This same principle is successfully applied in fusing special low-expansion glass to ordinary high-expansion glass. L. E. Saunders of Worcester suggested that Dr. Northrup try magnesium oxide linings, which also can be made very impervious.

Regulation of Electric Steel Arc Furnaces Using Movable Electrodes

W. G. Mylius of the Westinghouse Co. then presented his paper on "The Regulation of Electric Steel Arc Furnaces Using Movable Electrodes," describing a new regulator designed to give rapid and close regulation of heavy electrodes without "hunting." Assume a cold furnace. When the main circuit breaker is closed voltage coil *V* (see illustration) is energized, closing contact 3 and operating electrode motor continuously and at full speed until it comes in contact with the bath, when *V* will be de-energized instantly, opening the motor circuit. As no alternating current can exist in any electrode until two or more are in contact with the bath, current coil *A* will not be energized until that time, when contact 4 will be closed, causing the motor to raise the electrode and drawing the arc. When the pull of coil *V* builds up to that of coil *A*, the lever becomes horizontal and the motor stops. Current can be adjusted within a 20 per cent range by rheostat *C*.

Auxiliary contacts 5 and 6 respectively operate simultaneously with the "lower" or "raise" contactors on the motor control circuit and shunt part of coils *A* and *V*. When the induced change in pull by change in current and change in turns is sufficient to restore the lever to horizontal the motor will stop. A vibrating condition exists between control element and contactor whenever the current per phase is less than 15 per cent on either side of normal value, and the motors are subject to a series of impulses, the average length of which, being a function of the amount of furnace current, deviates at any instant. This also allows the motor to operate at high speed until the current has been brought to within 15 per cent of normal, when the speed is gradually reduced to zero, thus preventing "overshooting" and allowing automatic regulation on a cold charge. It is also impossible for an electrode to run down into the bath when current fails. One electrode can be withdrawn without disturbing automatic equilibrium in the two others. If voltage drops to zero, control levers balance and all motors stop.



SCHEMATIC DIAGRAM OF CONTROL ELEMENT CIRCUIT

A lively discussion followed. Mr. Bennett inquired about the power factor of the new regulator. According to his experience there was considerable lag in the reversing switches and hunting or overshooting is hard to eliminate. But even at an electrode feed of 24 in. per minute he has obtained regulation within ±2 per cent. Mr. Kellerher of Canada has found the Thury regulator to operate within ±1.5 per cent under normal conditions. E. L. Crosby, Detroit, pointed out that as far as the central station was concerned the interest in the regulator was not confined to "normal conditions." According to his experience ±10 per cent was nearer correct. Mr. Seede of the General Electric Co. said that up to 1913 or 1914 the step-by-step regulator had the field for itself. But in many a case it did not seem altogether satisfactory, and accordingly the continuous movement regulator was developed, which proved in many respects an improvement over the Thury. President Landis found that the mechanical feature of the regulating equipment and the quick response of the motors was most important in carbide furnaces with electrodes weighing 10 tons each. Mr. Seede reported that even with 10-ton electrodes the regulation could be kept within ±¾ per cent, using the continuous movement regulator.

A New Photo-Electric Cell

B. S. Cushman of Auburn, N. Y., presented a highly interesting paper by T. W. Case on a photo-electric effect in audion bulbs of the oxide coated filament type.

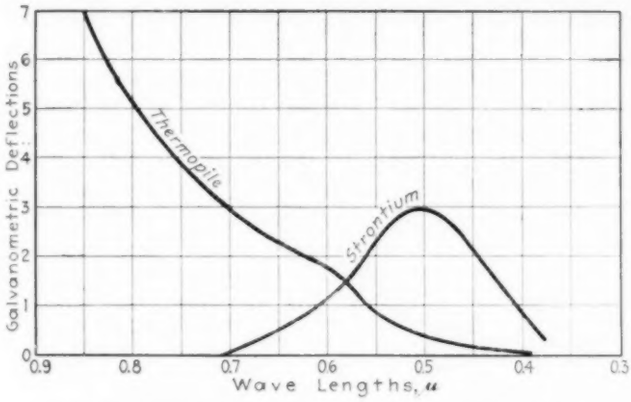


CHART SHOWING SENSITIVITY OF STRONTIUM CELLS TO LIGHT

Mr. Case reported that he has been able continuously to record daylight intensity for the past several months. The photo-electric effect on barium and strontium filaments in audion bulbs furnishes a current of 100 to 150 micro-amperes which actuates an automatic recorder.

Mr. Cushman showed two strontium cells and reproduced on the screen a number of daylight records which had been automatically registered by a Leeds & Northrup potentiometer. One of the cells had almost the same sensitivity as that of the human eye to light. The barium cells are sensitive to the longer rays, the strontium cells to the shorter rays. The sensitivity of the latter is shown in the illustration. In the discussion Dr. Richards suggested that the addition of a small amount of Sr to the Ba as a stabilizer might be similar in its effect to the addition of Ce to Th in the Welsbach mantle.

Electrolytic Products and Cells

The apparent irreversibility of the calomel electrode was investigated by A. W. Laubengayer of Cornell University. Some years ago Paschen had pointed out that a mercury anode polarizes much more strongly in hydrochloric acid than in sulphuric. Mr. Laubengayer finds that the apparent irreversibility of the electrode is not real, but is due to the formation on the surface of the mercury anode of a strongly adsorbed film of mercurous chloride, which offers a high resistance to the passage of the current. Why mercurous chloride should behave so differently from mercurous sulphate could not be established. The paper was briefly discussed by Dr. Fink, who suggested a microscopic study of the films.

Electrochemical Aspects of Photographic Development

"The Electrochemical Aspects of Photographic Development" was the title of the next paper, by Dr. S. E. Sheppard of the Eastman Kodak Co. In it he discussed previous work and added information being developed at the research laboratory of the Eastman Kodak Co. He discussed the physical chemistry of the development reactions, and pointed out the present unsatisfactory value of the measurements by electrical methods, which are entirely relative to the particular experimental conditions.

Electrolytic Manufacture of Paraminophenol

Another contribution by the Eastman research laboratories was presented by A. S. McDaniel. It dealt with a war-emergency investigation on the electrolytic manufacture of paraminophenol. The research was carried out jointly by Messrs. McDaniel, Schneider and Ballard.

Electrolytic Nickel

Two papers on electrolytic nickel gave rise to a very animated and lengthy discussion in which both practical and theoretically inclined members participated. The first, by William Blum, electrochemist of the Bureau of Standards, was on "The Use of Fluorides in Solutions for Nickel Deposition."

Charles P. Madsen was the author of the second paper, "Ductile Electrolytic Nickel." These two papers will be published in full in a subsequent issue.

A New High-Capacity Storage Battery

C. W. Hazelett gave a decription of a thin plate storage battery recently designed by him. The performance of this battery based on the amount of lead and active material varies from 50 to 200 per cent above that of the standard types. The higher percentages prevail at exceedingly high rates and at very low temperatures. It is machine made and a large decrease in cost of production has resulted. It is not subject to the mechanical defects and the variability experienced with present standard types.

It has been found practical to ship charged elements, wrapped in paper, to service stations for rebuilding batteries where the container is in good condition. This is due to the fact that the separators which hold the electrolyte like a lamp wick do not allow the plates to dry out any more than when immersed in electrolyte. By this system a complete battery may be rebuilt in less than an hour at approximately one-half the regular cost. This unusual principle is made use of where a non-spill battery is required by simply pouring out the excess acid when the battery is in use and replacing it while recharging. There is practically no decrease in capacity when this is done.

Since the life of a battery is practically always destroyed by buckling plates and short-circuiting or by the washing-off of the active material and since neither of these conditions is possible with the Hazelett storage battery, very long life would be expected. Conservatively speaking, their life is averaging from two to three times that of the standard types.

Walter E. Holland, of the Philadelphia Storage Battery Co., referring to Hazelett's battery, reported upon comparative tests carried out at his research laboratory. He felt that a number of the claims made by Mr. Hazelett—e.g., those in regard to voltage performance and capacity—were somewhat exaggerated.

Marsh Chlorine-Caustic Soda Cell

The final paper on the program was entitled "The Marsh Electrolytic Cell Batteries for Chlorine, Caustic Soda and Hydrogen," by C. W. Marsh.

Mr. Marsh gave a brief description of a high-capacity cell for electrolysis of brine, containing graphite anodes, corrugated sheet steel cathodes, with asbestos paper diaphragms clamped tightly to the edges of the cathodes. Arrangements are made for collecting both chlorine and hydrogen. Single cells are made to take up to 2,500 amp. The ampere efficiencies over long periods amount to 90 per cent; the power efficiencies 50 to 65 per cent.

The cell consists of three parts: a structural top with downward extended ends, anodes suspended from the

top, and a cathode clamped to the top and ends, forming the electrolyte compartment. The cell is supported from the top in a box or on insulated beams or suspended from the top through insulated bolts inserted in the top. A hoist operating from an overhead trolley beam or any similar overhead device is used for assembling the cell and to raise and lower the cell into position.

The structural top is like an inverted trough with downward extended narrow ends. The material may be stoneware, re-inforced concrete or other suitable material. Openings are provided in the top for brine inlet and automatic brine control device, brine level indicator, brine gage glass, chlorine outlet, cleaning holes and openings through which extend the top of the anodes.

The graphite anode consists of four, six, ten or any reasonable number of 1.75-in. (4.4-cm.) diameter graphite rods 24 in. (60 cm.) long arranged one above the other with spaces between and pinned to a rectangular section of graphite acting both as a support and a leading-in post. Pairs of these anodes are suspended from the top through clamps on the upper ends of the graphite posts.

The cathode consists of perforated sheet steel horizontally corrugated to conform to the surface of the horizontal graphite rods. The asbestos paper diaphragms are laid on the cathodes conforming to corrugations. The cathode is then clamped along the bottom edges of the top and against the ends with the diaphragm acting as a gasket. The cathode and the ends and top thus form the electrolyte compartment. The chlorine gas collects in the top above the brine. The caustic liquor forms on the cathode and is collected in the supporting box or by other trough-like receivers. The hydrogen gas may be recovered for use by confining the cathode in an inclosure, if the cell is suspended, or within the supporting box. The connections for electric current and for other purposes are made in the usual way. Connections are made along the top of the cell.

Social Features of the Meeting

The afternoons of Thursday and Friday were given over to sports and recreation. The golf tournament attracted a large number of enthusiasts. The course of the Sea View Golf Club was in exceptionally fine condition and the weather was ideal. Through the courtesy of Frank Hodson the members enjoyed the hospitality of the club, and so many were the attractions and inducements of the club that a goodly number of the electrochemists forgot entirely about the technical sessions "the morning after." In order to make the golf tournament doubly interesting the committee, with Arthur E. Gibbs as chairman, had arranged for a large number of attractive and practical prizes, generously contributed by the Westinghouse Co., Stellite Co. and Monel Co. The prizes were awarded on Friday evening at a gathering of the entire Society in the large auditorium of the Chalfonte. The occasion was a most impressive one. L. E. Saunders made the presentations with appropriate comments on the skill and veracity of the individual contestants. The first prize went to John A. Seede, who, due to his characteristic "continuously regulated" strokes, netted the lowest score. Then there were second, third and fourth prizes. Also prizes for special distinction: C. G. Schluederberg received a prize for covering the largest area of the course; H. C. Parmelee received a very fitting little prize, a pocket adding machine. Mr. Parmelee's distinction was the largest number of strokes. When asked for his score, the committee had mistaken his score for his telephone number. As to the "indoor sports," first prize in billiards went to Dr. J. W. Richards.

For Symposium on Corrosion of Metals and Alloys see page 841 of this issue.

Properties of Various Metals and Alloys

Some of the important properties of various metals and alloys have been summarized in the attached table by R. W. Woodward of the Metallurgy Division, Bureau of Standards. These values are typical, but should not be used for design purposes as of precise significance, especially if details of the special alloy in question are available. However, they form a most convenient reference table for data not commonly summarized, and are suitable for nearly all estimates.

Material	Tensile Strength, Lb. per Sq. In.	Elongation in 2 In., per Cent	Modulus of Elasticity (Lb. per Sq. In.)	Compressive Strength, Lb. per Sq. In.	Brinell Hardness Numeral	Density, Lb. per Cu. Ft.	Melting Point, Deg. F.	Coef. of Linear Expansion per Deg. F.	Resistance Ohms per Circular Mil-Ft.	Temp. Coef. of Resistance per Deg. F.
Cast iron	30,000	None	15,000,000	100,000	100	450	2,000	0.0000068	.....	.....
Wrought iron	50,000	35	25,000,000	30,000	125	480	2,760	0.0000066	60	0.00322
Low-carbon steel, annealed	60,000	35	30,000,000	40,000	...	490				
Low-carbon steel, cold-rolled	50,000	20	30,000,000	60,000	...	490			95	0.00183
Med.-carbon steel, annealed	80,000	28	30,000,000	50,000	135	490				
Med.-carbon steel, heat-treated	125,000	13	30,000,000	100,000	300	490	About	About		
High-carbon steel, annealed	86,000	33	30,000,000	.....	156	490	2,500	0.0000067		
High-carbon steel, heat-treated	200,000	10	30,000,000	.....	375	490				
Alloy steel, heat-treated	225,000	10	30,000,000	200,000	410	490				
Copper	35,000	50	17,000,000	.....	42	555	1,981	0.0000095	10.37	0.00220
Cast red brass	30,000	22	13,000,000	30,000	40	535	....	0.0000105	39.5	0.00055
Cast gun metal or govt. bronze	38,000	25	13,000,000	.....	64	545	....	.....	.....	.....
Manganese bronze, rolled	75,000	25	16,000,000	.....	100	525	....	.....	.....	.....
Zinc	12,000	..	11,000,000	25,000	48	445	786	0.0000163	36.5	0.00210
Aluminum	13,000	25	10,000,000	67,000	25	165	1,218	0.0000130	16.98	0.00216
No. 12 aluminum cast alloy	20,000	3	10,000,000	.....	55	176	....	.....	.....	.....
Duralumin, rolled and heat-treated	55,000	25	10,000,000	.....	...	175	1,200	.....	28.3	.....
Tin	4,000	35	4,000,000	6,400	14	455	450	0.0000126	67.9	0.00240
Lead	2,000	..	700,000	.....	...	710	621	0.0000164	125.0	0.00217
Genuine babbitt	.....	.....	.....	15,000	25	460	460	.....	.....	.....
Platinum	35,000	50	23,000,000	.....	...	1,340	3,191	0.0000050	66.0	0.00204
Gold	30,000	25	.....	.....	...	1,200	1,945	0.0000081	14.5	0.00206
Silver	45,000	..	9,000,000	.....	...	650	1,765	0.0000108	9.9	0.00222
Nickel	40,000	10	29,000,000	.....	76	570	2,646	0.0000071	64.0	0.00230
Nichrome	150,000	..	.....	.....	...	517	2,800	0.0000091	657.0	0.00024
Manganin	.....	..	.....	.....	...	.....	.....	.....	260.0	0.000006
Constantan	120,000	..	.....	.....	...	554	2,300	0.0000080	293.0	0.00001

Rochester Meeting, American Chemical Society

Report of the Sixty-first Meeting April 25-29, 1921—Council Meeting—Addresses at the General Meeting —Papers Presented at the Industrial and Engineering Chemistry, Dye, Rubber and Physical and Inorganic Chemistry Divisions, and at the Cellulose and Petroleum Sections

THE sixty-first meeting of the American Chemical Society was held at Rochester during the week beginning Monday, April 25. There were about 1,400 registrants, although the attendance was probably larger than this.

In view of the constantly growing burden of expense which the Society's meetings impose on their hosts, it was resolved at the previous meeting that greater simplicity of entertainment should be observed. To this general rule the Rochester Section conformed, but it made up for luxuries by perfect arrangements and order. Everyone was looked after, and every requirement was met without delay or inconvenience. It was a good meeting.

The Council Meeting

The Council meeting was called to order at 4:05 p.m. at the Rochester Club, President Edgar F. Smith in the chair.

Memorial resolutions were adopted in regard to the deaths of Dr. Albert C. Hale, formerly secretary of the Society, and Dr. I. D. Hines, for many years a member of the Council. Dr. George F. Rosengarten was re-elected to membership on the committee on national policy, succeeding himself. An invitation was presented from the Alabama Section to hold the spring meeting of 1922 at Birmingham, which was accepted.

Drs. Charles F. Chandler and William H. Nichols were elected to honorary membership. Under requirement of the constitution the names were acted on again by the members of the Society at its general meeting.

It was resolved that the Council express to the directors the hope that they absolve the printer of the Society's periodicals from any forfeit if he fails to deliver the journals regularly during the threatened strike of the printing trades for a 44-hour week. The conclusion was reached only after the increase in the cost of the periodicals which would follow the 44-hour week demanded in the printing trades was considered, and after a comparison was made of the rates of pay to journeymen before the war, now, and under the demanded advance. It was not from jealousy that the instructor in chemistry who receives less was unwilling to grant this request to his brother the compositor who receives more, but rather because he can't pay any more for his journals the while he must have them.

The proposal for a new section of the Society to be known as the Arkansas Section was adopted.

The appeal to Congress passed at the general meeting to safeguard the dye industry was passed by the Council.

It was determined that in future, if reports of committees are presented between meetings of the Council, these may be accepted and adopted by the advisory committee in the place of such action by the Council itself. This step was taken because sometimes it is necessary that preliminary reports be acted on to provide for further progress.

The committee on metric system offered resolutions urging chemists and manufacturers to use metric units in specifications, and it was resolved that authors be requested to use them in their papers and that the editors request them to do so.

Dr. Charles Baskerville reported for the committee appointed to meet the American Mining Congress. The purpose of this was to conserve the mineral resources of the United States, and progress was noted. On behalf of the Holmes memorial committee he did likewise. The report on occupational diseases in the chemical trades was an illuminating discourse even in the abridged form in which it was presented. Some of its features will be discussed on another occasion in this journal.

The advisory committee presented for action a resolution recommending to the Commissioner of Patents that a trained chemist be appointed as chief examiner. This was carried, as was also a resolution that the secretary of each division be authorized to demand the submission of any paper offered for presentation at any general meeting, and that the chairman and secretary of each division have the power to decline any such paper, if, in their judgment, it is unavailable.

The number of members at the end of 1920 was 15,582.

Dr. Herty reported encouraging progress in regard to the proposed Institute of Chemo-Medical Research which was formerly referred to as the Institute of Drug Research. The committee has lately been in conference with the Chemical Foundation. A very favorable report was also received from the committee appointed to co-operate with the Chemical Warfare Service. A meeting lately held at Edgewood Arsenal shows that this immensely important property of the U. S. War Department is now being conserved and held ready against the time of need for it. In the light of the report a resolution was adopted complimentary to Brigadier General A. A. Fries and his associates for their splendid work in this connection.

A number of other committees reported, and in conclusion the Council declared itself in favor of the principles contained in the Nolan bill, which died in Congress, and opposed to the so-called Federal Trade Commission rider, which provided for the disposal by the Federal Trade Commission of patents taken out by Government employees.

During a recess the committees were the guests of the Rochester Section at dinner at the Rochester Club.

The General Meeting

The General Meeting was called to order at the Chamber of Commerce by Frank H. Lovejoy, chairman of the Rochester Section, who introduced J. Ernest Woodland, chairman of the executive committee, and Mr. Woodland made an address of welcome. He then introduced J. Bernard Haggerty, secretary to Mayor Edgerton, who gave the freedom of the city to everybody there. Next E. J. Miner, president of the

Pfaudler Co. of Rochester, after a felicitous introduction, made an earnest appeal for the encouragement of research. He deplored the tendency, frequently observed of late, to discontinue efforts in this direction because of hard times. He declared that intelligent research is not an expense, but rather an investment in insurance for the future. He indicated also a danger that scientific men, instead of addressing themselves too much to theory, are likely to become too utilitarian, and thus, by neglect of pure science, to render themselves unfit to meet with clear vision the greater problems that come before them. He made an earnest plea to magnify the importance of pure science, for in the men of science of today rests the hope for the future. It was an address that might well be printed and used as a tract to circulate among the business men of the country.

President Smith then took the chair, and responded on behalf of the Society to the words of welcome in his own delightful and engaging manner. The act of the Council was confirmed by the unanimous election of Drs. Charles F. Chandler and William H. Nichols to honorary membership.

Prof. Bingham of Lafayette College in a short address made a plea for the practice of dealing and trading in units of the metric system. Much more can be done in favor of bringing it into use by acting than by talking. He urged that wherever and whenever possible supplies and materials be bought in metric units.

Dr. Raymond F. Bacon of the Mellon Institute in a short address urged upon members to bear in mind how in 1914 many industries were closed down for lack of a few pounds of some needed product, and advised that in most of the forty-two legislatures now in session there are bills pending designed to enforce prohibition of alcohol as a beverage that include provisions which, if passed, will do no less than wipe out several legitimate and important industries. These are in nowise related to the drink evil. Many of the proposed statutes are drawn with the best intentions, but their provisions are fraught with serious danger. The Volstead act was designed, according to its caption, to provide for the prohibition of alcoholic beverages and to promote the chemical and industrial uses of alcohol, but the latter feature is being wholly forgotten in the legislation which threatens.

Captain G. B. Hide made an appeal for the Near East relief, and H. C. Howe announced that the fourth table of chemical and physical constants will be out by July.

Senator Wadsworth for Chemical Preparedness

Senator James W. Wadsworth, Jr., made no pretensions to chemical scholarship, but said that in the Congress of the United States he was far from being alone in the lack of it. He has only lately recognized the utter dependence of industry upon chemistry, and he has been made alive to the fact that if this science does not go forward with us we cannot progress as a nation. He would not undertake to instruct the audience before him in the relation of their own profession to national defense, but he had lately spent a day at Edgewood Arsenal, and wished that others might go there and see what it means to the people of the United States and to future generations. It is of staggering size. The people of this country, regardless of their politics or their opinions as to foreign or domestic affairs, should count themselves fortunate in having this great plant for their protection, held in readiness and administered by so able and competent an authority as General Fries.

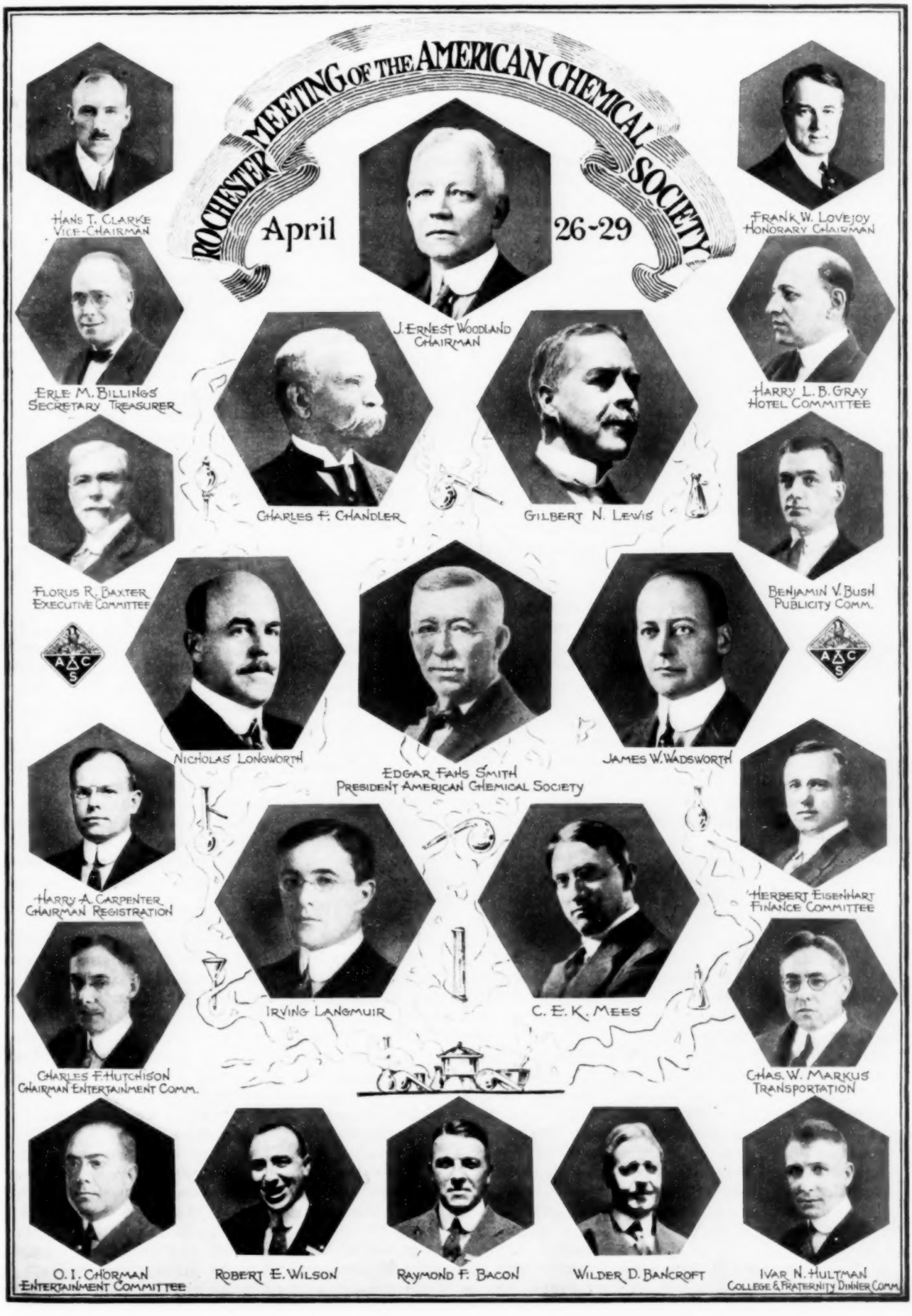
He had participated in considerable discussion in relation to the Chemical Warfare Service, more particularly in the Committee on Military Affairs, and this discussion had at times been rather lively.

The head of the department himself and the Chief of Staff had contended against a separate Chemical Warfare Service, and had wanted it merged, or, rather, submerged, in the Engineers Corps. The members of the committee had a very slight understanding of the subject, but when they learned that 30 per cent of the casualties were due to gas, they had the wit to see that the service was not negligible, and legislation to keep it as an integral part of the army was finally enacted. In its last session Congress also appropriated money to make at Edgewood 120,000 masks and 120,000 extra canisters, which are the best masks that have been made anywhere, although even they do not protect against all known gases. He believes, however, that if we are compelled to go to war again, and the enemy uses gas, we shall have made good provision against it, and not be utterly unprotected in that respect as we were before. He believed it safe to say that Congress will not permit this service to perish.

There are, he said, conflicting views current as to the proper size for the United States regular army. Personally he does not favor a standing army that is too large, but rather believes in the proper training of citizens who in case of war have to do most of the fighting after all. But it is possible to make the regular army, which must serve as a nucleus in time of war, too small. With an army of 280,000 men, which is the maximum figure considered, the number of officers in the C.W.S. will be 100 out of a total of 17,800, and 1,200 enlisted men out of 280,000. But if the total number be reduced in the measure proposed by some earnest legislators, the enlisted men in the C.W.S. will be reduced to four officers and 400 enlisted men. This would be almost fatally inadequate.

Another point of information that was being learned is that high explosives depend on nitrates, and that if we do not produce them by chemical means we must send 10,000 miles away for them. He had never read in history of a people able to defend themselves unless they were self-reliant and independent. Now the best measure for national defense is that the means for defense be made by the people themselves. A government alone cannot provide for it in days of peace. Such preparation must be included in the peaceful occupations of the people. No government is competent enough or pure enough to do this thing of itself. For this reason he has opposed proposals to launch the United States Government in great industrial enterprises whereby it would invade the domains of business to prepare itself against the day of war. He repeated that since the people must fight the wars it is they who should prepare for them—and they should make nitrates as a legitimate business industry.

He would like to think that war will never overtake us again, but he can't be sure; and if we are not sure we are not warranted in neglect. In conclusion he rejoiced that a great organization like this, which builds for the future, gives its thoughtful consideration to the security of the country, and he looked upon it as a happy augury that if, in future, danger again threatens us, we shall have such a large body of skilled men on whom we can call.


ROCHESTER MEETING OF THE AMERICAN CHEMICAL SOCIETY
April 26-29
HANS T. CLARKE
VICE-CHAIRMAN
J. ERNEST WOODLAND
CHAIRMAN
FRANK W. LOVEJOY
HONORARY CHAIRMAN
ERLE M. BILLINGS
SECRETARY TREASURER
CHARLES F. CHANDLER
GILBERT N. LEWIS
HARRY L. B. GRAY
HOTEL COMMITTEE
FLORUS R. BAXTER
EXECUTIVE COMMITTEE
BENJAMIN V. BUSH
PUBLICITY COMM.
NICHOLAS LONGWORTH
EDGAR FAHS SMITH
PRESIDENT AMERICAN CHEMICAL SOCIETY
JAMES W. WADSWORTH
HARRY A. CARPENTER
CHAIRMAN REGISTRATION
HERBERT EISENHART
FINANCE COMMITTEE
IRVING LANGMUIR
C. E. K. MEES
CHARLES F. HUTCHISON
CHAIRMAN ENTERTAINMENT COMM.
CHAS. W. MARKUS
TRANSPORTATION
O. I. CHORMAN
ENTERTAINMENT COMMITTEE
ROBERT E. WILSON
RAYMOND F. BACON
WILDER D. BANCROFT
IVAR N. HULTMAN
COLLEGE & FRATERNITY DINNER COMM.

President Smith asked all to rise, and while the audience was standing, he expressed in a few eloquent words the sincere thanks of the Society to Senator Wadsworth for his splendid message.

Congressman Longworth on Tariff Schedules

Congressman Nicholas Longworth followed. He said he had lately called at the most distinguished residence in the country, and that its occupant, who is the most powerful man in the country at this time, had said to him: "I hear you are going to address the American Chemical Society. That is good; but what the chemists of America most need is not talk, but protection."

The speaker said he was now chairman of that subcommittee of Congress which is framing the chemical schedule, and he admitted that it was a difficult job. Nobody can tell the cost of products, either here or abroad. It is a great field of guess-work. Therefore it is idle to pretend to follow the old slogan and declare that a proposed tariff bill will equalize the difference in costs, if they can't find out what these are! The market prices are by no means trusty guides, because of fluctuations. Even well-known chemicals have varied in price in thousands of per cent. One product widely used has had a range in the last few years of from 10c. to $4 a pound. As far as possible, he hopes that we may go back to specific duties. But even these are often unreliable and a specific duty that might be a proper one today might, in some cases, be wholly out of proportion three or four months hence. On the other hand, as soon as we consider ad valorem duties we face the problem of foreign exchange, and that is another source of trouble. The only way to meet the situation is to have a valuation of foreign imports based on the wholesale values of the same products in this country, when it becomes necessary to fix an ad valorem duty.

Another great difficulty is that we have changed from a debtor to a creditor nation. How then can Europe pay its debt to us if we bar Europe from our markets? Again, how can we meet the low labor costs that prevail, for instance, in Japan?

The speaker believed that the true solution consists in maintaining a bargaining counter, and in having three rates of duty to apply:

1. As a regular rate.
2. A maximum rate to those who do not treat us as favorably as they do other countries.
3. A minimum rate to be applied only by order of the President and to be used in exchange, as, for instance, to silks from France against outgoing chemicals from the United States to France.

There is one class of merchandise for which no rate of duty even to a thousand per cent will suffice, and that is coal-tar dyes and other coal-tar products. We must not only put duties on some, but keep others out altogether. In the bill he introduced into the last Congress he proposed a licensing system, but the plan met the objection that Americans do not like to apply for licenses to carry on their business. What he hopes to bring about will be to divide dyes listed by the Tariff Commission into three groups, viz.:

1. Those that are not imported at all because they are made here in abundance and sold at reasonable prices.
2. Those occasionally importable because they are not made here in sufficient quantity to care for the industries that need them.
3. Those that are not made here at all and which may be imported freely.

Mr. Longworth is convinced that Germany is awaiting the day when she may flood this country with coal-tar products in such a manner as to kill the domestic industry. The German factories are running full time; they have not been injured, and their labor and chemical forces have not been called on to fight in the army. If we want to save this industry for the United States, with all that it means, we must put a flat embargo upon certain German products, and he believes that this time it will be done.

Another difficult matter is that the bill will hardly be ready for the President to sign after its passage through both houses before November or December, whereas the War Trade Board goes out of existence by July 1, or possibly sooner. To make provision against such dumping of German goods into this country some unusual legislative steps will have to be taken, but he has hopes of this also. In short, Mr. Longworth believes that the members of both houses have finally come to realize that our preparedness for defense lies in our chemical industries.

In conclusion he repeated Senator Wadsworth's observation in regard to the immense advantages to the country in having the American Chemical Society to which it can turn when under threat of war.

President Smith again asked the audience to rise and in the name of the Society he thanked Representative Longworth for his happy and heartening address.

Measurement of Color

Dr. E. K. Mees of Rochester gave an illustrated talk on "The Measurement of Color." The development of the colorimeter has proved that the subject is of interest to manufacturers as well as to physicists and chemists; the range of industries calling for color measurement including makers of soaps and makers of soups. We can measure the stimulus that produces the sensation of color, and we can measure the sensation itself. Thus the stimulus is found in the cause of the sodium flame, whereas the sensation is produced directly by a dandelion. While to us the color of both is alike, they are wholly different in the spectrum. To examine the stimulus we must use analytical methods, while to measure the sensation our methods must be synthetic.

Blue Eyes and Blue Feathers

Prof. Wilder D. Bancroft, in talking on "Blue Eyes and Blue Feathers," said there is no pigment in blue eyes, but that the sensation of blue is explained by the presence of a thin layer of minute particles between which the long red waves pass without touching them, whereas the short blue waves are sure to strike them so as to be deflected, or at all events so scattered that they produce the sensation of blue. Gray, green and brown eyes are due to more of these particles against which the impact of longer waves makes itself manifest. He followed with an explanation of the color of blue feathers.

The chameleon and the flounder produce different effects of color by the arrangement of particles in their skins. Slides were shown of a patient flounder which took protective coloring from a large number of bottoms over which it was placed, and it showed amazing attempts at conformity to the surfaces beneath it. Over sand and over granite rock and over a considerable number of various bottoms it became almost

invisible, whereas when such an unusual surface as a chessboard or other regular figured bottom was provided, the poor fish did its best, but couldn't quite meet the requirement. A test that seemed unfair was to place it so that the head was over a black surface, and the rest of it over white. The fish saw only the black, and turned as dark as it could all over. It turned as near white as it could with the conditions reversed. The protective coloring is due to a volitional change in the particles under the surface of the skin, and copies more or less closely what the fish or chameleon sees. It is not due to pigmentation of the skin.

Surface Films as Plastic Solids

Robert E. Wilson, director of the Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology, gave a general address on the structure of surface films. By a variety of new and ingenious methods it was demonstrated that the stability of most, if not all, stable bubbles is due, not to the mere lowering of surface tension, but to the formation of *plastic solid*, rather than *liquid*, films at the liquid-gas interface. These films are probably gel-like in structure, and owe their formation to the concentration of the bubble-forming material (such as soap) at the interface. The same essential conclusions were also shown to apply to the interfacial films between oil and water, which are formed by the ordinary emulsifying agents. Here again the presence of a plastic solid, rather than a liquid film, is the main factor in preventing coalescence of the drops. Plastic solid films also appear to play an important part in lubrication.

Prof. Wilson also showed that the presence of these solid films, at all except the lowest concentrations of materials such as sodium stearate and saponin, caused erroneously high results in the ordinary (Du Nuoy or drop weight) methods of measuring surface tension between solutions and air or oil, etc. The measurements in such cases really represent the sum of the surface tension plus the frictional resistance to rupturing the film. While it has not yet been found possible definitely to separate the two effects, they are at least of the same order of magnitude, and in many cases the frictional forces are larger than the surface tension forces, as witnessed by the grotesque deformed and pointed, and yet stable, drops, of which pictures were shown.

Indeed, the results may account for the hitherto unexplained fact that certain concentrated soap solutions will spontaneously emulsify oil, which would appear to indicate a *negative* interfacial surface tension, and yet oil dropped into the solution gives a reasonably definite drop weight which calculates over to *positive* value for the interfacial surface tension.

Relation Between the Stability and the Structure of Molecules

Irving Langmuir amplified his previous presentations of the octet theory by showing the part played by electrons held in common between the positive fields of two atomic nuclei forming a molecule. The fundamental hypothesis states that stability is attained when the negative shell has its full quota of electrons as based on the structure of the inert helium series. An outer shell is not stable until it contains eight electrons; thus a stable molecule differs from the inert elements mainly in having more than one positive nucleus and holding one or more electrons in common. Double bonds exist where two electrons are held in common by two nuclei and triple bonds exist where three are shared.

Ionization of Electrolytes

The activity of the ions or ionic strength of an electrolyte forms the basis of theoretical work with solutions. Prof. Gilbert N. Lewis has recently calculated tables from laboratory determinations which will form a very valuable addition to the present store of constants. It is predicted that mixed salt concentrations at saturation can be calculated and of course all work on electrolysis will be greatly benefited. The paper will be published in the current issue of the *Journal of the American Chemical Society*.

The Chamber of Commerce Luncheon

At the luncheon in the Chamber of Commerce there were over 1,000 present, and Dr. Arthur D. Little of Boston gave a popular talk. Business men, he said, deal in dollars. They go out after them and they have accountants to keep record of them, and they discuss them constantly. But dollars are only symbols of things, while things are materials and labor; and labor creates value only as it works on things. Now the nature and control of materials is the province of chemistry. Therefore chemistry is a partner in the manufacturer's business; a closer partner than the Federal Reserve Bank or the labor union. We have lawyers to look after man-made laws, but chemistry deals with its own laws, and a chemist is a counselor of chemical laws. Men who have to do with materials need chemical service, and since we have but one chemist to every 7,000 of our population, it is time that live men began to look around for good ones. One ounce of whiskey in 55 gal. of water makes a dilute drink, and that is the ratio of our mixture of chemists to people in this country; of men who study the ways of materials.

He cited a great number of instances in which the chemist had saved situations and added to the wealth of the nation, and explained in an illuminating manner the chemical foundation of production. He showed it should be the controlling consideration in regard to raw materials, how it finds suitable substitutes for materials needed that are too costly or too rare, and how it finds new outlets for products. He explained the value of scientific control of production, as well as how the chemist finds new uses for existing plants. The audit and sheet balance is a record of past performances. The research laboratory provides for and aids in future performances.

Petroleum Section

The question of organizing a Petroleum Section of the American Chemical Society was first taken up and discussed seriously in February of this year; the approval of the national officers was obtained early in March and the work of enrolling members and preparing a program was begun at once. Encouraging comment was received and about fifty persons indicated their intention of joining the Section; but the real prospect of success could not be judged until the test of holding a meeting had been applied. However, at no time after Wednesday morning, April 27, when the Section first met, was the fate of the project in any doubt.

In the field of petroleum so much of the research work and the information available are in the hands of the representatives of the industry that their support and co-operation are absolutely essential to success. That

such support and co-operation were being given was indicated by the presence of the chief chemists and technical directors of many large oil companies, a number of whom had traveled long distances to be present. These and an adequate representation from the universities and research institutions filled to overflowing the small room first assigned for the meetings of the section and two movings were necessary before adequate quarters were found.

The time of the Section was divided between the business of organization and a short but very interesting program of papers. In arranging for the meeting, the Council, through the national officers, had appointed Dr. T. G. Delbridge, of Philadelphia, chairman and Dr. W. A. Gruse, of Pittsburgh, secretary. The organization, as voted by the meeting, provides in addition for a vice-chairman and an executive committee of five members, who are to conduct the business of the Section; the payments of dues were decided upon, and in order to facilitate and stimulate intelligent discussion of papers it was voted to circulate, prior to a meeting, abstracts of all papers to be presented; the circulation of written discussion was also considered. Standing committees on papers and on membership were provided for.

Petroleum Hydrocarbons That Cannot Be Distilled

The first paper on the program which followed the preliminary organization was one by Dr. Charles F. Mabery, of the Case School of Applied Science, Cleveland, by seniority and by merit dean of investigators in the field of petroleum chemistry in this country. Dr. Mabery's paper was on "A Method for the Separation of Petroleum Hydrocarbons That Cannot Be Distilled." The principle employed was that of fractional solubility in hot ether-alcohol; by repeated treatments the author has separated individual hydrocarbons from the residue of petroleum oils non-volatile *in vacuo* above 300 deg.; the hydrocarbons were identified by specific gravity and molecular weight determinations and by elementary analysis and were found to belong to the series C_nH_{2n-6} to C_nH_{2n-12}. The compositoin of the heavy fractions of petroleum oils have long remained *terra incognita*, and Dr. Mabery has given many younger investigators a splendid example of patience and courage in undertaking such difficult and time-consuming work.

Some Chemical Considerations of Petroleum Refining

Dr. B. T. Brooks, in a paper on "Some Chemical Considerations of Petroleum Refining," made a plea for a closer connection between pure organic chemistry and petroleum technology, and for better dissemination of information now in the files of private organizations. Dr. Brooks pointed out some influences tending to make the oil industry more like what a good industry should be, chief of which is the growing scarcity of crude oil. He characterized present-day practice in oil refining as highly unscientific, and in an interesting review of recent work explained some of the possibilities for technical improvements. Dr. Brooks voiced the opinion of many present when he called attention to the need in this country of a journal resembling the *Journal* of the Institution of Petroleum Technologists, where persons engaged in petroleum work could find both an adequate record of all reliable work and could also be assured of a medium which would bring their researches to the attention of all those interested. This paper will be published in full in a subsequent issue.

Experiments With Oils and Oil Mixtures

Dr. R. E. Wilson, director of the Research Laboratory of Applied Chemistry at M. I. T., presented two interesting papers. In the first, read by himself, Dr. Wilson explained a very accurate but simple method of determining the initial and various partial condensation temperatures of kerosene- or gasoline-air mixtures. A Socony kerosene mixed with air in the proportion of 14.5 to 1 gave a dew-point of 232 deg. F. at one atmosphere total pressure, and a Socony gasoline under identical conditions gave 97 deg. F. The data were presented for a wide range of conditions. Of great interest were the data which the work supplied on the total heat of kerosene and kerosene-air mixtures. The second paper, jointly with L. W. Parsons and read by Dr. Parsons, described work carried out co-operatively with the Vacuum Oil Co. on a method for measuring the true color of oils, using the Dubosq instrument and giving results on a scale directly related to the Lovibond. The unknown oil was measured in a thin film of known thickness, and compared with varying thicknesses of an oil solution of standard color. The method permits the determination of batch colors from effluent colors during filtration, provided the weight of oil is known.

Other Papers Presented

Dr. F. H. Garner read a paper written jointly with Dr. W. F. Faragher on "Removal of Hydrogen Chloride From Chlorohydrocarbons." The effect of temperature and various catalysts on this reaction, so important in the preparation of unsaturated compounds, was studied, and a method was presented for the preparation of olefines.

C. J. Rodman presented a new and very accurate method for determining very small percentages of water in transformer oils, depending on evaporation *in vacuo* and absorption by phosphorus pentoxide.

Dr. E. W. Dean and F. W. Lane, of the Bureau of Mines, reported, in a paper read by Dr. Lane, on a study of the variation with temperature of the viscosity of some typical American oils and their fractions. The authors found that their curves could be represented by a general equation, and pointed out that there was no reliable method for calculating viscosities for oils for which less than three values have been determined at different temperatures.

Dr. W. A. Gruse read a paper by W. F. Faragher, F. H. Garner and himself, in which a résumé was given of a study of the measurement of unsaturation in cracked gasolines and unsaturated hydrocarbons by the determination of the iodine number; particular attention was paid to the variation of the iodine number with time and quantity of material.

Dr. W. F. Parish, in a paper presented in his absence by W. F. Faragher, reported on the interesting topic of reclaiming used motor oils; he brought out the fact that the reclaimed oils (mixed with soda ash and blown with steam) were better than new oils, after the removal of absorbed heavy ends of motor fuel, because the high temperatures in the explosion chamber served to decompose the lighter constituents. Dr. Parish brought out the desirability of perfecting a standardized form of reclaiming apparatus which could be used by persons without technical training, and emphasized the

fact that the oil drawn from a motor after a thousand miles' running is not a waste product, but can easily be reclaimed.

Dr. C. E. Waters reported on a continuation of his well-known work on the oxidation of lubricating oils. The paper was read by Dr. F. R. Baxter, and was a study of the catalytic influence of various metals on the oxidation of oils being tested in the Waters apparatus. The influence of copper was so marked that the author closed with a suggestion that transformers be made of zinc or aluminum and that bearing metals should contain no copper.

Division of Industrial and Engineering Chemistry

The meeting of this division, which has always been looked forward to in preceding years with anticipation as a source of profitable information for chemical engineers, was a distinct disappointment to the members who heard the papers presented. While there were several of extreme high merit as scientific presentations outlined in the following paragraphs, the very poor average called forth some caustic comments from the members at the close of the session.

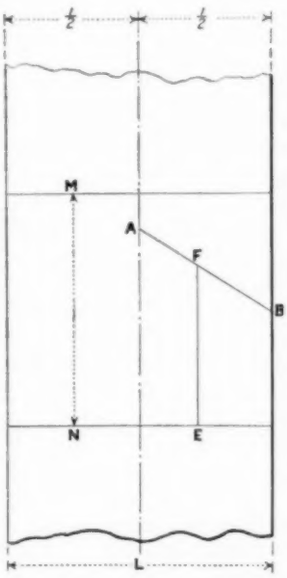
Rate of Drying of Solid Materials

Those who expected the drying symposium to be worth while were not disappointed in the excellent scientific address delivered by W. K. Lewis on "The Rate of Drying Solid Materials." This paper was the result of seven or eight years' scientific investigation at the Massachusetts Institute of Technology and dealt with the mechanism of evaporation of water from the surface of solids.

All solids hold water adsorbed on their surfaces in moist air. Solids can never be dried below the equilibrium point, which depends on the humidity and the temperature. The only water which will evaporate is the free water. This adsorbed water behaves as though its equilibrium moisture were the same as that of the solids.

For the simplest mathematical example sheet materials were chosen to prove out the process involved.

The accompanying diagram shows a sheet of material under consideration. The distance *MN* represents the space on this sheet under test. Let this sheet be divided by the center line as shown, then the space included between the lines to the left of the center line represents the original moisture content of the sheet. The line *AB* represents the average concentration of moisture, or the differential gradient throughout the sheet. It is not really a straight line, but will do for practical industrial approximation.



The moisture within the body of this material must be permitted to get to the surface. Evaporation at the surface and diffusion of moisture from the material are the two processes involved in getting rid of this moisture. Both are really a problem of diffusion, since the moisture must be diffused through the air. There is a difference in the operation of the process of removing the moisture at low temperatures and high temperatures when figured mathematically. Let w equal the surface concentration of water. Then

$$\frac{dw}{dt} = bx$$

where b is a constant depending upon the drying conditions and x is the moisture content of the surface.

$$\frac{dw}{dt} = \frac{8abw}{(2a + bL)L}$$

When diffusion is rapid as in the case of wood pulp, then

$$\frac{dw}{dt} = \frac{2bw}{L}$$

When the evaporation is slow,

$$\frac{dw}{dt} = \frac{4aw}{L^2}$$

Experimental data were presented to prove this in the form of numerous curves. In the first case time in minutes was plotted against per cent of moisture to show when the moisture content of the solid reached the equilibrium of that of the air. Another curve was presented to show the rate of twine drying.

Most sheet materials shrink when they dry, and allowance must be quantitatively made in the equation when these curves are plotted. Other slides showed the adiabatic air-drying of heel board corrected for shrinkage. The rate of diffusion is proportional to the difference between partial pressure of moisture on the surface and partial pressure of the drying air.

Further curves were presented to show that the rate of drying is inversely proportional to the thickness of the material and that the drying is constant at constant air velocity. The rate of drying then varies with the air velocity.

It was found during these investigations that the ratio of water taken out of the substance to the heat put into the drying operation exactly equals the specific heat of the substance. Materials in which diffusion is slow as in the case of tightly twisted twine, for instance, dried at a rate inversely proportional to the square of the thickness. In the case of soap, where the diffusion is extremely slow, the moisture recedes into the center of the cake, slowing up the drying process. There is no relation between diffusion and the rate as occurs in swift drying shown by the formulæ, which datum confirms the theory given in the first paragraphs. Removal of an organic solvent by drying from fibrous material operates just like drying out of water.

In summarizing, the conditions surrounding the process of drying are: (1) Care so as not to injure material dried; (2) adequate air supply; (3) adequate heat supply; (4) adequate time to complete the process. The first three items are taken care of in industrial drying today, but the fourth is now empirical and the author believes that the time factor may be quantitatively worked out so as to permit the drying of industrial materials on a definite scientific basis.

Theory of Atmospheric Evaporation

W. H. Carrier's paper on the theory of atmospheric drying involved the development of numerous drying formulæ, as well as the treatment of the subject from a physical and thermodynamic viewpoint. The work was carried out with particular reference to compartment drying, although the data may be applied to other types.

Since this work involved so many calculations, it would have been better published than read before the members, since it only consumed time. It was impossible to follow the rapid reading of so many calculations.

The Compartment Drier

A. E. Stacey, in collaboration with W. H. Carrier, presented a paper on the compartment drier, treating the subject from a chemical and physical viewpoint. The work contained the operations involved in the process of compartment drying and also covered the method of drying by silica gels. Numerous slides were presented showing all types of compartment driers now installed in the industry.

Direct-Heat Rotary Drying Apparatus

Like the preceding paper, the one given by R. G. Merz, on the direct-heat rotary drying apparatus, covered little material that is not already known to the users of driers. It was an exposition of the different mechanical developments of rotary driers and discussion of the industries where they may be applied. The rotary drier was first developed for the drying of ores in the mining and metallurgical industries and is now finding a wide application in the chemically-controlled industries. It is adapted to installations where large quantities of materials must be dried at low temperatures, when such material will not be injured by continued abrasion in the revolving barrel.

Tunnel Driers

G. B. Ridley spoke from an engineering viewpoint on the installation and operation of tunnel driers as applied to the dehydrating fruit plants on the Pacific Coast. These driers are similar in construction to the well-known tunnel kiln used in the ceramic industries, and may be operated by the application of steam, hot air or direct heat, steam being the most easily regulated where low temperature can be used. Trays of the material are loaded on rack cars, which are in turn wheeled through the long tunnels and submitted to the drying air. Excellent engineering data were presented to show methods of scientific control by charts and diagrams. The tunnel drier is cheap and convenient, will handle any material, can be accurately controlled, etc. It is better to enter the cars at the hot end of the tunnel where the material will stand the high initial heat, because more rapid drying prevents case-hardening or leathery consistency being given the material; and in the case of fruit, maintains the flavor. This drier operates more economically with large air circulation to control humidity. Efficiencies of furnaces or driers range from 92 to 98.5 per cent. Direct heat is the most efficient way if correctly applied.

The Spray Process

R. S. Fleming, of the Merrill-Soule Co., Syracuse, N. Y., talked on the spray process of drying as originally invented in Germany in 1901, for the drying of milk, blood, albumen, etc. The manufacture of powdered milk by this process was started in the United States in 1905. It was later modified to provide for the condensation of the liquid before it enters the driers.

The apparatus needed consists first of an air scrubber to clean the air before introducing to the spray room. The air may be water-washed or better yet filtered through cotton wool layers. Blowers provide the air pressure and in some cases an exhauster is used on the finishing end of the system. Steam pipe is placed over which the drying air may be passed and finally a set of sprays operate in the drying chamber where the hot air hits the fine material. This chamber usually consists of a large rectangular room with the liquid sprayed into the air from the ceiling. The atomizer proper may be air-sprays, operated by compressed air or by introducing the liquid under hydraulic pressure. Finally, a dust collector may be installed to operate in conjunction with a filter at the end of the system to save the fine dusts.

In actual operation very intimate mixture of air and particles is secured, causing an intense evaporation on the surface of each droplet. This occurs so rapidly that the droplet is kept cool. It is an especially efficient way to obviate injury by heat where some organic substances are handled. The greatest danger for such substances is when the mass is in the stage between a sirupy and dry condition. This state is passed instantly in the spray-drying process. The expense of drying by this method is too high for inexpensive substances, but where milk, sugar and other organic liquids, including blood and albumen, are to be dried, the efficiency more than overcomes the high cost.

Where concentrated liquid is fed into the sprays larger particles are produced, so that there is less bulk and greater solubility when the substances are to be redissolved in water when used. Among other types of substances glucose has been successfully dried. This paper holds interest for many people who have special problems in drying difficult liquids.

Vacuum Drying

B. J. Van Marle discussed the subject of vacuum drying and the various equipment used, including rotary, shelf and drum driers. There are no universal driers for any material and the fields overlap. The quantity of product and cost are considerations in deciding which equipment will best handle same. The cost of vacuum driers is high because strength to resist pressure is needed. They are not suitable for large quantities, particularly the shelf type. This paper was a good exposition of the manufacturers' line of equipment in various fields where it is employed.

Tests of Counter-Current Kelp Driers

E. C. Spencer described the test on small counter-current kelp driers which showed that the thermal efficiency of the counter-current drier was 78 per cent on a 4-ton drier as compared with 88 per cent on a unidirectional drier.

Discussion on Drying Symposium

The informal discussion after the presentation of these papers developed the fact that in the spray process of drying usually about one-third of the total solids obtained is collected in the dust collector at the end of the process; also that the particles dry in a spherical condition. Preconcentration affects size of particle more than any variations in the pressure on the spray. Sugar has not been successfully dried by the spray process because the particles land on the floor in a molten condition and therefore form a sticky mass. Glucose, however, behaves admirably.

A. V. H. Mory further brought out that it is better to cause the liquids to boil in vacuum drying. He further developed that in compartment drying in an original design, the air was introduced at the top of the

tunnel at one end and drifted through the material to the bottom of the tunnel at the other. In putting a blower counter-current to the current of drying air an equal distribution of air was obtained through the entire mass or space of the drier. Mr. Stacey attributed this result to the additional amount of air entering the drier, but Dr. W. K. Lewis showed that it was due to the high velocity causing a turbulent motion which brought more of the same air in contact with the material. In other words, when the velocity of air is slow it simply drifts through, drying the nearest edges of the pieces in question, while in the case of a rapid velocity of air it becomes turbulent and presents continually unsaturated portions of air to the wet mass to be dried. The critical velocity from the straight line to the turbulent motion is greater in the case of air than water. Turbulent motion in a drier is exceedingly important.

Crosby Field, of the Allied Chemical Corporation, criticized the types of papers presented in that the manufacturers did not go into mechanical details. In general they design driers by hanging metal around the drying idea, and this metal is not distributed to the best mechanical advantage. Mr. Gertz, of C. O. Bartlett & Snow Co., laid the responsibility for this condition on the purchasers of driers, who buy on cost rather than quality of design. The manufacturers are therefore forced to skin the design down to meet the competition. It was very evident on the whole that the members were not satisfied with this symposium.

Other Papers

Method of Testing Filter Cake Obtained in Refining Vegetable and Animal Oils

Charles Baskerville presented samples and described the methods for treating filter cake obtained in refining vegetable and animal oils. Crude linters are introduced into the filter cake to act much in the same manner as hair in plaster. When the cake is removed it is treated with sulphuric acid solution and the linters are separated in centrifugals. More than 93 per cent of the 5½ per cent free fatty acid found in the cake coconut oil was recovered. There is a considerable overall saving of free fatty acid, say about 1 per cent, and the process has been installed in six plants which obtain a saving of 6,000 tons per annum. The samples presented showed very excellent recoveries of cottonseed oil, soya-bean oil, peanut oil, coconut oils, etc.

Application of the Cottrell Precipitator to the Wood-Distillation Process

L. F. Hawley, of the Forest Products Laboratory, described research carried on in the use of the Cottrell precipitator to recover mists in the wood-distillation process. The so-called dissolved tar which is removed from the pyroligneous acid by distilling off the acids is not a tar like the coal tar consisting of oils and pitch, but is really a pitch containing very small proportions of oil and soluble in the pyroligneous acids on account of the presence of acetic acid and methanol. Such contaminating pitch is carried over in the form of a fog or mist consisting of very fine drops of liquid pitch.

It is found that since the Cottrell precipitator is able to precipitate fine particles of liquid or solids when carried in a stream of gas, it should be introduced into this process, and was therefore connected between the retort and condenser of the small wood-distillation apparatus. During the first run the precipitator was heated so that the vapors at the outlets from the precipitators had a temperature of about 160 deg. C. On examining the inside of the precipitator it was found that a deposit of hard pitch had been built up from the inside surface of the tubes. The temperature of the precipitator was then run near 100 deg. C. to collect the small amount of liquid with the hard pitch. This tar was not very thick even at ordinary temperature and was sufficiently liquid to drain from the tubes without any difficulty.

Although the small-scale experiments have not removed the last traces of pitch and although a satisfactory acetate of lime could not be made from the directly neutralized pyroligneous acid, yet they have shown that the general idea of precipitating tar from hot vapor is a possibility and that in a commercial-scale apparatus the formation of secondary tar may be more complete before the vapors leave the retort, and therefore a purer pyroligneous acid can be obtained by this method. The complete equipment will be described in a future number of Chemical & Metallurgical Engineering.

Alcohol and Chemical Industries

J. M. Doran, in discussing the use of alcohol in the chemical industries, showed how the present and future development, notably the dye industry, is intimately bound up with the alcohol industry.

The Eighteenth Amendment to the Constitution and the Volstead act affect this key industry far more vitally than the average chemist is aware. Title III of the national prohibition act accords special treatment under the law to industrial alcohol, but overshadowing all are the prohibition features of Title II of the same act, wherein alcohol is defined as intoxicating liquor and made subject to the restrictions surrounding intoxicating liquors. In order to free the alcohol industry and dependent and allied chemical industries from the strangling rules surrounding liquor under which no industry can prosper, it is of utmost importance that alcohol be divested of its beverage character. The handling and use of pure alcohol in any industry is now a liability rather than an asset.

Under the denaturing provisions of the national prohibition act it is possible both to enforce prohibition and to assure the healthy development of industrial alcohol. This may be done by using for denaturant some of the chemicals that subsequently follow in a process where the industrial alcohol is to be used. In other words, select the denaturant for each particular user and introduce it ahead of time, thus preventing the use of the solution for a beverage. This would place the alcohol on a non-beverage basis, thus making the technique more efficient in the disposal of the liquor phase. The educational and research institutions should take this matter up if we are to have a healthy chemical industry.

Valuation of Oil-Bearing Seeds by Free Fatty Acid of the Oil

Lehman Johnson, in a paper on the valuation of oil-bearing seeds by free fatty acid of the oil concludes that since below 2 per cent free fatty acid a well-settled crude cotton oil is normally prime, making the required color and 9 per cent refining loss, and since above 2 per cent free fatty acid the refining loss on settling oil admits very fairly of a factor, the method presented of the value of the oil-bearing seeds by the percentage of

oil obtained through extraction of the thoroughly dried seed with petrolic ether and determining the free fatty acids from this same extract is quite accurate and fair enough for commercial purposes, and should eventually be substituted for the "cut and count" of damaged seed as now provided by the Interstate Cottonseed Crushers' Association, which says, Rule 2, Section 4: "The percentage of damage shall be determined by counting the damaged and immature seeds." The same method is probably applicable to other oil-bearing seeds where the oil is refined by the alkaline method.

Detection of Carbon Monoxide

C. R. Hoover presented a method for the detection of carbon monoxide with apparatus designed for accomplishing same. The importance of the detection of quantities of carbon monoxide physiologically harmful is shown by the large number of deaths each year due to asphyxiation, practically all of which are caused by the presence of this gas. An increasing number of workers in the industries, as well as operators of automobiles and other motor vehicles and users of gaseous fuels, are exposed to this peril. Carbon monoxide is an insidious danger, since it is colorless and odorless, giving no warning of its presence through the unaided senses. In spite of numerous ingenious chemical and thermometric detectors, the effect of the gas upon small animals has been practically the only method successfully employed.

The newly developed apparatus consists of a rubber aspirator bulb attached to a nickelplated brass tube about 6 in. long. A few squeezes of the bulb draws a sample of the air being tested through the brass tube, which contains activated charcoal to remove gases likely to interfere with the test for carbon monoxide, and forces it out through a small glass tube containing a mixture of fuming sulphuric and iodine pentoxide. If carbon monoxide is present, this white solid turns varying shades of green, increasing in depth as the amount of carbon monoxide increases. By comparison with a permanent scale attached to the apparatus the amount of gas present is readily determined. The whole determination requires but a few seconds and after a few minutes the color disappears from the glass tube and the test can be repeated.

More recently an improved device has been constructed. A piston and cylinder with positively operated valve replaces the aspirator bulb. This insures a definite volume of gas for each test and a shorter time for the taking of a sample. The material acted on by the carbon monoxide, which is prepared from iodine pentoxide, fuming sulphuric acid and granular pumice stone, has been rendered more sensitive so that quantities of gas as small as 0.03 per cent can be definitely shown and fairly accurate analyses of amounts up to 2 per cent quickly made. The detector is designed for use in coal and metal mines, industrial plants using or producing gases containing carbon monoxide, garages, telephones or telegraph conduit tunnels, holds and stoke rooms of ships, boiler rooms, etc. In most of these the simple form of detector has already been successfully used. In comparing the results of this detector with chemical analyses, the following results were obtained:

Bulb Method	Piston Method	Laboratory Analysis
0.5	0.6	0.583
.5	.4	.431
.3	.2	.161
.2	.125	.127

Microscope Illumination With Reference to Brownian Movement and Combination Lighting

A. Silverman showed some experiments with the microscope illumination with reference to Brownian movement and combination lighting, the first part of this paper dealing with the Brownian movement. The slide with a hollow-ground depression in which the colloidal solution was placed had dipped into it the lens of the microscope, which in turn was surrounded on the edge of the depression by a circular lamp. On examination it was found that the particles displayed Brownian movement much more distinct than ever before observed.

The second part of the paper dealt with combination lighting to show in proper detail a fossil insect imbedded in amber. In the contrast illumination of this with white background beneath the slide the fossil appeared only as a dark outline with no detail. Placing a black background below the slide some detail was shown, but it mainly appeared as a white outline on the black. The third slide, showing light background with reflected light thrown on the top of the fossil, gave an exceedingly fine illumination of perfect detail brought out by the illumination.

Relation of Structure to Free Alkali in Sodium Silicate Solutions

William Stericker, of the Mellon Institute, in discussing the relation of structure to free alkali in sodium silicate solutions, stated that the literature was full of contradictions on this subject, and that the textbooks were erroneous. The alkali silica ratio in sodium silicate solution varies from 1:1 to 1:4. It has not been conclusively proved that sodium silicate solutions are independent of the free alkali content. Concentrated solutions are non-hydrolized. When a layer of water was placed on a layer of silicate, fine hair lines were seen to wriggle up through the water, showing there was some substance present which went quickly into solution in the water, and if left to lie long enough, an intermediate layer was formed between the water and the silicate solution. In studying a solution of silicate the sodium hydroxide exists in higher concentration at the interphase than elsewhere. Basic dyes were adsorbed on the surface of the particles, while acid dyes were not adsorbed by colloidal particles. When a basic dyestuff is used as an indicator, it gives the concentration at the interphase. In testing with hydrogen ion concentration apparatus it was found that the alkali is not hydrolized even in dilute solution. It was further found in testing by this method that the concentration of the dilute portions away from the colloidal particles was really determined in the two-phase system.

Colloidal particles may contain electric current, and this current may account for the discrepancy discovered. Heating of the solution affects the degree of hydrolysis.

It is then difficult to determine the amount of free alkali in sodium silicate solution. No general method can be devised. Attention is called to these facts so that any attempt to determine free alkali must be made under the same concentration as that under which the material is to be employed in industrial use—that is, dilute or concentrated—and the temperature of the solution must be kept the same as that in the condition under

which it is going to be used. The Mellon Institute is continuing on this research.

Compression Evaporization

Gustav Carlsson gave an illustrated talk on the new method of concentrating liquids developed in Europe recently. This compression evaporation is effected by heating the liquid in containers to boiling point and compressing the evolved vapors, thus raising the temperature.

For complete description of this process see Mr. Carlsson's article in CHEMICAL & METALLURGICAL ENGINEERING, vol. 24, page 645, April 13, 1921.

Action of Lime on Greensand

R. Norris Shreve, in discussing the action of lime on greensand, delivered the most complete engineering paper of the session. Greensand or glauconite, found in large deposits along the coast of New Jersey, is treated with lime for the recovery of potash salts. Analyses of this greensand show 3.4 per cent potash, 0.4 per cent soda and 49.8 per cent silica. The Eastern Potash Corporation is building a plant at New Brunswick, N. J., for the recovery of potash and the manufacture of brick from the residue. This plant will treat 1,000 tons of sand per day with about 900 tons of lime to produce 65 tons of potash or an equivalent amount of other potash salts. Ten rotary kilns will be installed with a capacity of 1,800 tons of lime per day and will be equipped with revolving coolers. The lime is added to the greensand in digesters in the presence of water at high temperature and pressure. Caustic soda will be obtained as a byproduct. The liquors from the digestors are run into four large quadruple-effect evaporators for treating the weak caustic solution. These evaporators are 18 ft. in diameter and 55 ft. high. Investigation has been made as to the various methods of handling this greensand and the result of grinding has shown that the best digestion is obtained where 90 per cent passes 200 mesh.

Digestion of the greensand is best carried on under high temperatures. The effect of ratio of water used shows that digestion increases with the amount of water, but it does not pay to handle the water beyond the ratio of one part of lime, one part of greensand to five parts of water. The effect of substituting caustic potash solutions in the ratio of one to one to five of greensand, lime and liquid, shows that the action is retarded somewhat, but nevertheless it is economical to re-use the wash liquors. Five thousand tons of water is handled in the plant daily. The plant is so arranged that the weak liquors treat the fresh greensand and lime and the water from the filter presses is re-used.

Testing variations in the lime ratio at different digestion periods, all tests being made at a high temperature of 470 to 483 deg. F., proved that the ratio can be brought down to 0.85 part of CaO without interfering with the reaction. Investigation was further made with accelerating solutions of various salts such as calcium chloride, sodium nitrate and potassium nitrate.

The plant has a capacity of about 20,000 tons of potash per year, and as the market is somewhat limited other potassium compounds will be produced, particularly potassium nitrate and potassium sulphate. If either one of these latter salts is added to the primary charge, it acts as a catalyzer, or accelerator, and increases the potash yield from 61 to 81 per cent.

It is concluded that for best recovery it is necessary to grind the glauconite to pass 200 mesh, to maintain the digestion temperature at about 470 deg. F. for one hour, and to use a ratio of greensand, lime and water of 1 to 0.9 to 5. Sodium nitrate was found to be the best accelerator. The product as it comes from the plant is an exceedingly pure one, being equal to the c.p. product of commerce.

Water Resistance of Treated Canvas During Continuous Exposure to Weather

F. T. Veitch, in discussing the water resistance of treated canvas during continuous exposure to weather, showed that three formulæ gave 100 per cent results. These formulæ involve the use of petroleum, wool grease, beeswax, lead oleate and asphalt. All these increase the resistance of canvas to water as well as to wear in a marked degree.

Business Meeting

Because of the mass of papers of indifferent value that are being presented before the Industrial and Engineering Chemistry Division it was moved by A. Silverman that the division appoint a committee to pass on all papers before they are accepted for delivery before the division. The chair is to appoint this committee, which will require that the papers be submitted at least two weeks in advance of the meeting. This committee shall have the right to reject any or all papers, and to "bluepencil" such sections of the paper as are deemed of no immediate interest; furthermore, the chair is to have the power to limit the discussion on papers so that in cases where only a few of the members are interested the discussion can be carried on outside of the meeting. The chair shall also have the power to decide whether the papers be read in abstract or in full. The motion was carried.

This action will eliminate the long historical and bibliographical papers that have tired out the members of the division until they left the meetings and missed the points of real scientific and engineering interest.

Dye Division

The meeting was well attended, and the discussion sincere and lively. Most of the papers were of interest only to the dye chemist, although a wider interest attached to some of them. Generally speaking, but with notable exceptions, they lacked that informative value for the development of which the division was established. American manufacturers have not yet got to the point where they dare let very much be said.

The first paper was "A Contribution to the Estimation of H Acid," by Henry R. Lee.

A New Process for Alizarine

The next was "A New Process for Alizarine," by Charles W. Schaffer. This was a preliminary report of laboratory development of a process for producing alizarine with benzene as the raw material. The general interest consists in the fact that it is one of several processes that seem to be coming along to produce alizarine from some material other than anthracene. When anthracene is removed from coal tar according to current practice, the pitch is made unavailable for roofing and road making. Now these uses for pitch are fundamental to the coal-tar industry in the United States, while alizarine is, in effect, the key to the vat dye industry. It is, therefore, of leading importance that a source of alizarine outside of anthracene

be discovered. With abundant alizarine we should not worry about vat dyes in large quantities.

Bleaching Dyed Cotton Fabrics

Dr. J. Merritt Matthews of New York presented a paper on "Bleaching Dyed Cotton Fabrics." This of itself was technical, but the discussion brought out some interesting points. It was generally agreed, as Dr. Matthews said, that the dye industry has been one-sided in its development in this country, with major attention to the making of intermediates and dyes, but inadequate attention to their application. Dr. Derrick of Buffalo confirmed this point, and expressed the wish that the color laboratory at Washington would take up some of the fundamental problems. We are far from adequately informed of the science of dyeing, and we do not know what the actual processes are that take place when a dye attaches itself to a fiber. An immense amount of research in the abstract problem and in the physical chemistry of dyeing is urgently needed, and yet single manufacturers cannot well undertake it. (Our own impression is that unfortunately they do not undertake it.) There are many old dyes that are made in abundance that could be made far more fast and stable and even—in short that could be made far better than they are—by fundamental study, by the exercise of reasonable invention, and by greater care in the dyeing. With this Dr. Matthews was in hearty agreement, and said that the fast colors of antiquity were not due to better dyes, but that the ancient methods of dyeing were more careful, more laborious, and better than ours. Advances have been made in economy at the expense of quality in the art. At this point a gentleman familiar with the textile industry observed that the methods of the dye-houses in mills are deteriorating rather than improving for two specific reasons: The price of coal is such that every process is shortened to the minimum in order to save coal, and the requirements of organized labor are such that the time of men engaged in the work is also made as short as possible.

Industrial Needs of Chemistry in America

Dr. William J. Hale spoke on "The Industrial Needs of Chemistry in America," and these immediate needs are real chemists. It would have been a godsend to industry if some smart Aleck manufacturers who "have no use for physical chemistry" and who have been scrapping organized research laboratories on the ground that fundamental research is "deadwood" had heard and digested this paper. In some cases, however, it would require a crowbar to aid their mental digestion. Dr. Hale commented with favor on Dr. Derrick's suggestion of co-operation with the color laboratory and other available facilities for fundamental research, and at the Thursday morning session the subject was taken up again.

The chairman, Dr. Davis, recognized that a competent committee to co-operate with the Government laboratories would probably contain men engaged with manufacturing concerns and that it might involve suspicion or misunderstanding of their purposes, despite the best intentions.

Dr. Derrick wasn't worried about that. He said we are inviting ourselves to confer with the Washington authorities, and that the very purposes that the division had in mind were of interest to all manufacturers and users of dyes.

Dr. Alsberg, chief of the Bureau of Chemistry, said that color laboratories were established to render public service, and that the makers and users of colors were its particular public. This public did not have to invite itself; it was already invited.

In regard to the character of research it is almost impossible to get appropriations for that of a fundamental character without giving the specific results that are expected to ensue from it. To impress the mind of Congress any work must be presented to it in terms of money value. It must be translated into dollars. This is always difficult, and sometimes impossible, and yet we can hardly blame Congress for it. It is our business to inform the public of the need of these things, and then Congress will learn from the public. Most of the money appropriated for the Bureau of Chemistry goes to the enforcement of the pure food and drugs act. In order to demonstrate the need of work in pure science for the benefit of legislators Dr. Alsberg had tried to segregate the work in pure science that is being done in order to solve very practical and definite questions, but he found it impossible to make the separation that he desired. The bureau has no appropriation for any theoretical work of which the immediate practical value is not self-evident. He believes that fundamental research is especially the province of the Government laboratories and those of universities and research foundations, while that in applied science is more particularly the province of industries—always, of course, within reason. Another point is that many problems call for years of work; they cannot be solved in an hour; and only the Government is rich enough or long-lived enough to carry them through. We know how pressing is the need of such fundamental knowledge, but the public does not. As soon as we can tell the public of it so that it can understand, then Congress will also understand, and will act. Some industries such as farming, and certain branches dealing in food products, must be helped in a practical way, but in an industry which calls for such meticulous chemical control as that of dyes the information needed is the nature and behavior of reactions, vapor pressure, eutectic points, and fundamental studies within the domain of physical chemistry. Dr. Alsberg said that he, and he believed his successor, whoever this may be, would be glad to give the members of such a committee an official, advisory status, and he believed the Secretary of Agriculture would take the same attitude.

Importance of the Dye Industry

Dr. Derrick again referred to the lopsided nature of the industry of which Dr. Matthews spoke because the underlying principles of the uses of dyes are not known. The Germans are working along this line and we are not. There are a great number of scientific problems, fundamental problems that are not understood either here or in Germany or anywhere else. To solve them requires so many different kinds of scholarship that no industrial organization can afford to make the necessary appropriations. And yet the men of just such varieties of scholarship are available in Washington. He was delighted at the broad-minded way in which Dr. Alsberg had presented the attitude of the Bureau of Chemisthy. Here is a way to get many of the problems solved. The people interested are the whole public rather than individual manufacturers. Dyes are merely raw materials; the thing desired is good textiles, etc., at once cheap, and dyed, not only

properly, or even in the best way known; they should be dyed in the best way possible, which is an entirely different thing.

Committee Appointed to Secure Co-operation With the Government

A great deal of enthusiastic discussion followed for which we have not space, but the general agreement was the need of fundamental research. A motion was passed to create a committee of three, of which Dr. Derrick should be one, to confer with the Bureau of Chemistry at Washington and other available establishments, with the view to planning for co-operation, under all necessary formalities, and under the approval of the governing body of the American Chemical Society. It seems probable that this committee will have the opportunity to succeed in this important work.

Dr. C. R. de Long of the Tariff Commission sent a record of the dyes imported in 1920, which we print elsewhere.

Cellulose Section

This was the first meeting of the section and the crowded attendance, together with the high standard of the papers presented, indicated a widespread interest in the subject. The topic which attracted greatest attention was that of the symposium relating to "Our Future Supply of Liquid Fuel," and the ensuing discussion indicated a lively appreciation of the gravity of the subject. The communication by T. A. Boyd of the General Motors Co. showed that the number of automobiles and trucks in use in the United States has increased from about 1,000,000 in 1912 to about 9,000,000 in 1920, or an average increase of over 1,000,000 a year. Crude oil, the principal source of motor fuel for motor vehicles, has shown an increase in domestic production from around 220,000,000 to 440,000,000 bbl. per year, so that while the number of motor vehicles in use has multplied about ninefold, the output of domestic crude oil products has only doubled.

The production of crude oil has increased since 1909 about 140 per cent, that of gasoline about 800 per cent, but the number of automobiles registered has risen 2,570 per cent. The consequent enormous demand for gasoline has been met, partly by increasing the boiling point range, partly by extracting liquid hydrocarbons and partly by cracking. According to the U. S. Geological Survey the unmined supply of petroleum is roughly 6,000,000,000 bbl., which, if the present rate of production is maintained, will be exhausted in about thirteen years. From these figures it is apparent that some other source of liquid fuel must be found, and cellulose in the form of plant life appears to offer interesting possibilities.

Possibilities of the Tropics to Furnish Materials for Cellulose and Carbohydrates

It was shown by H. N. Whitford, professor of tropical forestry, Yale University, that a possible solution is to be found in the utilization of the solar heat of the tropics for the growth of cellulose materials such as cassava, nipa palm and especially bamboo. Thus an area in the Philippines of about 63,000 square miles, if planted with selected species of bamboo, might be expected to yield cellulose material from which an amount of alcohol equivalent to the present annual consumption of gasoline could be obtained. Other interesting data relative to cassava and the nipa palm were given, as for instance that the present annual product of "nipa alcohol" from quite a small area in the Philippines amounts to 3,000,000 gal.

Possibilities of a Future Fuel Supply From Our Forests

R. C. Hawley, also of Yale University, pointed out that the forest resources of the United States are capable of supplying waste wood annually to the amount of 11,000,000,000 cu.ft., equivalent to 2,475,000,000 gal. of a colloidal fuel to be obtained by peptization of a entirely neglected.

In view of the important results recently obtained by F. B. LaForge of the Bureau of Chemistry on the production of furfuraldehyde from corn cobs, it was of interest to learn that if the total waste cellulose material represented by the corn stalks and cobs could be utilized for the production of furfuraldehyde, it would yield approximately 3,900,000,000 gal., or sufficient to replace our present supply of gasoline. The material has been tried out as a motor fuel and has the great disadvantage of causing pre-ignition in the motor, but it is confidently believed that this could be overcome.

In the subsequent discussion of the papers and of the part to be played by the chemist attention was drawn to the possibility of two solutions of the fuel problem: (*a*) the joint production of furfuraldehyde and alcohol from some suitable available raw material, and (*b*) the use of a colloidal fuel to be obtained by peptization of a material such as cellobiose by means of alcohol, the former to be obtained by the bacterial decomposition of wood. In view of the necessity which would arise, in attempting to use such a colloidal fuel, of altering the entire design of the engine to the Diesel type, earnest consideration should be given to the cheapest sources of supply of alcohol and furfuraldehyde. In the first place it is not practicable to use domestic cereals, as this would interfere too seriously with the nation's food supply, but the utilization of cornstalks and cobs, waste wood and, further, of the growth in the tropics of something in the nature of a cross between a cereal and a tree species in order to obtain (as stated by one member) "a kind of bamboo filled with starch" is what is required as a source of raw material. The problem is a fascinating one for the cellulose chemist and offers abundant opportunity for research work and the exercise of the imagination.

Effect of Adding Various Chemicals to Wood, Previous to Distillation

The paper of L. F. Hawley on the effect of adding various chemicals to wood, previous to distillation, showed that an increase in the yield of products could be obtained by subjecting the wood to a previous treatment with 0.5 per cent of sodium carbonate. Curiously enough, the sodium remains combined as carbonate at the end of the operation.

In the discussions relating to the manufacture and commercial application of nitrocellulose it developed that there is no recognized standard method for determining the viscosity of such solutions and a committee is to be appointed of those interested, with G. E. Esselen as chairman and E. Bingham as consultant, to work out the details of a standardized, acceptable procedure.

The value of the work being carried out at the Forest Products Laboratory on cellulose materials has been recently recognized, on the one hand by the increased

Government grant of $100,000 and on the other by the contribution of the American Paper and Pulp Association. It is considered highly desirable that the chemists should have time available for the compilation of monographs and special theoretical papers and the following resolution was adopted by the section and ordered forwarded to the director of the Forest Products Laboratory:

"The Cellulose Section of the American Chemical Society, in session at Rochester, N. Y., congratulates the director on the increased Government grant and looks forward to increased activity in the matter of the acquisition and publication of fundamental scientific data and monographs."

The chemical changes involved during the infection and decay of wood pulp, by Bray and Staidl, also of the Forest Products Laboratory, brought out the immense financial loss caused by this factor and threw light on the nature of the changes occurring. It is this phase of the subject which is being financed by the A.P.P.A.

The Microstructure of Wood

One of the interesting contributions was that by Allen Abrams on "The Microstructure of Wood," this work having been financed by the Meade Paper and Pulp interests and carried out at Massachusetts Institute of Technology. It represents a new technique by means of which chemical changes in the cell structure taking place under the influence of chemical and other reagents can be readily followed from a study of microscopic sections stained or otherwise treated.

European Practice in Cellulose Acetate and Dopes During the War

It was brought out in the communication on "European Practice in Cellulose Acetate and Dopes During the War," by Philip Drinker, that there exists a mass of valuable information accumulated by E. C. Worden and himself during 1914-19 in a special Government report which they presented on the subject. A resolution was passed unanimously by the section urging the Government to publish such information in the report as is not regarded as confidential, since it is considered that this would be of great value to the industry.

Action of Hydrobromic Acid on Cellulose and Related Derivatives

In the paper dealing with "The Action of Hydrobromic Acid on Cellulose and Related Derivatives," by Harold Hibbert and Harold S. Hill, higher yields of bromomethyl furfuraldehyde were recorded than obtained by Fenton. The fact that dextrose gives a yield of 10 to 15 per cent of the same crystalline derivative destroys the value of this reaction as an argument for the ketonic structure of cellulose.

A Proposal for a Standard Cellulose To Be Available for Research

A paper by B. Johnsen, of the Hammermill Paper Co., on "A Proposal for a Standard Cellulose to Be Available for Research" gave rise to an animated discussion. The author suggests the advisability of having the section arrange for the manufacture of a considerable amount of an especially pure cellulose to be available for the cellulose chemist and by the general use of which for research purposes strictly comparable results would be obtained. It was stated that the Atlas Powder Co. had expressed its willingness to manufacture the material. A committee was appointed, consisting of B. Johnsen, a representative of the Atlas Powder Co. and the chairman of the Section (with power to add to their number), to draft a tentative scheme of purification, the chairman agreeing to bring this to the attention of interested parties for their criticism and comment and to have the matter referred to the Section for final action at the September meeting in New York.

Rubber Division

When one considers the great depression which has existed in the rubber industry for the past six months the Rubber Division was very fortunate in having any spring meeting at all. Only two papers were presented from manufacturers' laboratories. All the others came from the universities, the Bureau of Standards or makers of materials. However, the sessions were well attended by about fifty interested men and women. Evidence of constructive thinking and fair mindedness was manifested in the discussion which followed each paper.

Tentative Procedure for the Analysis of Rubber Goods

Tentative methods of analysis, compiled by W. W. Evans from the methods of the joint rubber insulation committee, the Bureau of Standards and the underwriters' laboratories, had been mailed to all members of the Division previous to the meeting. The discussion took the form of outlining various profitable changes in the methods as presented. These changes were referred to the analytical committee, which is composed of the following men: Messrs. Collier (Bureau of Standards), Dugan (Goodyear), Wiegand (Ames Holden MacCready), Simmons (Akron University) and Evans (Goodrich). Very briefly the methods adopted are as follows:

Acetone Extract—Use underwriters' apparatus and method except dry to constant weight at 70 deg. C.

Unsaponifiable Material in Acetone Extract—The committee is to determine once and for all whether alcoholic soda or potash is preferable. Otherwise the method is similar to that of the joint rubber insulation committee. Calbeck proposed treating the alcoholic soda solution with a small amount of silver nitrate to decompose any aldehydes. His solution keeps longer without discoloring. In all such determinations running a blank is strongly recommended.

Free Sulphur—Name changed to "Soluble sulphur." Regular bromine oxidation method recommended.

Chloroform Extract—Usual procedure.

Alcoholic Potash Extract—Usual procedure, but comments under "Saponifiable matter" apply here.

Total Sulphur—Bureau of Standards method. Caution: use only the bromine saturated nitric acid solution and allow no free bromine to come in contact with the sample.

Ash, Sulphur in Ash, Barytes—As per underwriters' practice.

Thermal Conductivity of Some Rubber Compounds

A paper on "Thermal Conductivity of Some Rubber Compounds" was read by A. A. Somerville. A series of thin sheets of rubber with thermocouple junctions between were placed on a steam chest kept at 100 deg. C. On top of this pile a vessel containing melting ice maintained a temperature of 0 deg. C. By comparing the time necessary for the center thermocouple to reach

maximum temperature for various stocks a measure of their relative heat conductivity was obtained. The conductivities of stocks containing 3 and 10 per cent sulphur on the rubber and 10 per cent sulphur with 2 per cent accelerator were found the same. This value was taken as unity. The following table contains the values obtained with 10 per cent sulphur, 2 per cent accelerator and 150 per cent zinc oxide or its equivalent volume of other filler based on 100 parts of rubber:

Base stock	1.00
Zinc oxide (150 per cent)	1.65
Glue	.87
Asbestine	.91
Lampblack	1.02
Gas black	1.14
Crimson antimony	1.15
Whiting	1.23
Lithopone	1.33
Magnesium carbonate	1.45
Soapstone	1.45
Clay	1.67
Litharge	1.78
Red oxide	1.86
Fossil flour	1.90
Barytes (ground)	2.28
Barytes (precipitated barium dust)	2.65
Frictioned fabric	1.07

The state of cure of the various stocks was found to have no effect on the conductivity.

Contribution to the Knowledge of the Resins of Hevea Rubber

G. Stafford Whitby and J. Dolid presented a paper entitled "Contribution to the Knowledge of the Resins of Hevea Rubber." By the use of glacial acetic acid certain crystalloids have been isolated from the acetone soluble portion of hevea rubber. Constituent *A* gives an acetate soluble in chloroform melting at 80 deg. C. The insoluble portion melts at 169 deg. C. Constituent *B* melts at 62 deg. C. and *C* melts at 128 deg. C. Its formula is $C_{22}H_{44}O$. Dr. Whitby has definitely established the presence of a rare sugar, quebracheetol, which is related to inosite, and has the following structural formula:

$$\begin{matrix} CH(OH) & & CH(OH) \\ (CH_3O)HC & \rightleftharpoons & CH(OH) \\ (OH)HC & & CH(OH) \end{matrix}$$

Solubility of Gases in Rubber as Affecting Their Permeability

"The Solubility of Gases in Rubber as Affecting Their Permeability" was treated in a paper by C. S. Venable and Tyler Fuwa. Many years ago Graham proposed that the permeability of a gas through a membrane depended on, (*a*) the concentration and (*b*) the rate of motion of the molecules. In other words, that $P = K \times C \times D$, K being a constant. Transposed to our present terminology this means that the permeability P equals the pressure p times the square root of the molecular weight divided by the solubility S.

N_2, CO, O_2 and CO_2 give fairly good constants. But hydrogen, methane and ammonia are badly out of line. This has led the authors to propose that an additional factor depending on the size of the molecules of the respective gases should be incorporated in Graham's formula.

Summarizing: 1. Rubber holds gas by true solution.

2. The solubility is directly proportional to the pressure.

3. Solubility decreases with increase in temperature.

4. The solubility is independent of the degree of vulcanization.

5. There is a relation between solubility and permeability, of which size of the molecules is probably a factor.

Analysis of Rubber Goods Containing Antimony Sulphide

S. Collier and M. Levin described a method of analysis of rubber goods containing antimony sulphide. The method involves separation of fillers by means of cymene, and solution in acid. Antimony is separated by means of H_2S and determined in the regular way.

The Direct Determination of Sulphur of Vulcanization

S. Collier and M. Levin presented a paper on "The Direct Determination of Sulphur of Vulcanization." Sample is acetone extracted, then dissolved in cymene. Fillers are removed by centrifuging and filtration. The soluble portion is evaporated to dryness and sulphur is determined in the usual way with nitric acid and bromine.

It is somewhat doubtful if this method gives in all cases the true sulphur of vulcanization. The sulphur combined with MR and substitutes apparently would be included. The method doubtless has applications in pure gum stocks or cases where the composition is known.

Volume Increase of Compounded Rubber Under Strain

At the Philadelphia meeting a year and a half ago H. F. Schippel pointed out that compounded rubber increases in volume when strained. He demonstrated this fact by indirect methods. Henry Green has been able to observe and photograph, by means of the microscope, the actual changes which take place. Working with rather coarse barytes, he obtained cavities at either end of the barytes crystals. He noted that some particles developed cavities when the piece containing them was stretched, but some did not. In seeking an explanation of this he advanced the theory that many of the particles were surrounded with an adsorbed film of air. In such cases the rubber did not adhere to the crystal. In other cases when this film was absent there was adhesion between the rubber and crystals and no cavities were obtained.

Speaking of zinc oxide Mr. Green stated that in a stock containing 100 volumes of zinc oxide to 100 volumes of rubber no agglomerates were discernible under the microscope.

Influence of Piperidine-piperidyl-dithiocarbamate on Vulcanization

G. Stafford Whitby and O. J. Walker described experiments on the influence of piperidine-piperidyl-dithiocarbamate on vulcanization. The experiments were performed in the absence of zinc oxide. In a high sulphur stock (10 per cent sulphur on the rubber) piperidine-piperidyl-dithiocarbamate becomes a mild accelerator with excellent aging properties. With zinc oxide it is very powerful.

A Rapid Bomb Method for Determining Sulphur in Rubber Compounds

Experiments using a bomb made by the Standard Calorimeter Co. of Moline, Ill. (the manufacturer of the

Parr calorimeter) were described by W. W. Evans and Ruth E. Merling. The samples consisted of 0.2 g. rubber suitably packed in sodium peroxide with a little sugar and potassium chlorate on top. Ignition was secured as in a Parr calorimeter. The total time for running a determination was placed at three hours. Results follow:

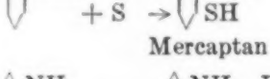
S incorporated	Nitric Acid-Bromine Method	Bomb Method
....	2.23	2.39
....	2.75	2.98
3.5	3.55	3.73
6.35	6.41	6.36

The method works with high amounts of sulphur as in an antimony tube or hard rubber analysis. A blank should be run, as c.p. sodium peroxide sometimes contains sodium sulphate.

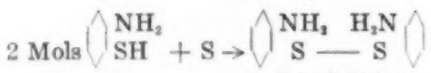
Reactions of Accelerators During Vulcanization

Carbo-sulphhydryl accelerators and the action of zinc oxide were treated by C. W. Bedford and L. B. Sebrill in a paper which described the action of certain accelerators during the cure, advanced a theory for the activating effect of zinc oxide and described several intensely interesting experiments on the auto-vulcanization of cement without the application of heat—i.e., curing at room temperature. The paper may be summarized briefly as follows:

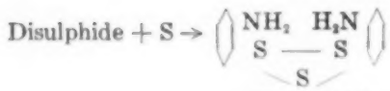
1. Sulphur reaction of aniline produces carbo-sulphhydryl group, forms ortho-amido-thiophenol, which on oxidation forms the disulphide *o*-di-thio-aniline.



Mercaptan



Disulphide



Polysulphide

2. Kratz, Flower and Shapiro found that rubber can be vulcanized, without free sulphur being added, by ammonium hydrogen sulphide (NH_4SH). Bedford explains that the air dissolved in their milled stock was sufficient to oxidize the NH_4SH, giving some free sulphur.

3. Meta-diamines readily react with sulphur, forming disulphides of the type C-S-S-C, which readily take up more sulphur to form disulphide-polysulphides. Such compounds may be dissolved in hydrochloric acid without separation of the polysulphide sulphur except on long standing. Meta-toluene-diamine reacts readily with sulphur without evolution of ammonia. The accelerating value of meta toluene sulphur reaction products is thought to be due to the formation of polysulphides.

4. On the other hand, para-toluene-diamine loses ammonia and hydrogen sulphide. Para-phenylene-diamine behaves similarly.

5. Porritt has proposed sodium phenolate as an accelerator. There is evidence in the literature that such compounds react with sulphur as low as 100 deg., giving thio-phenols, disulphides and polysulphides, in the same manner as with aniline or the meta-diamines.

6. Aldehyde ammonia reacts with sulphur in boiling alcohol, giving off ammonia and hydrogen sulphide. The red brownish residue has little curing power.

7. Some of the factors influencing the rate of formation of carbo-sulphydryl and hydrogen sulphide polysulphides are temperature, presence of various secondary or inorganic accelerators, mass action of sulphur and the concentration of the materials reacting.

8. The hydrogen sulphide reaction product of *p*-nitroso-dimethyl-aniline is an accelerator. Para-nitroso-dimethyl-aniline speeds the reaction of carbon disulphide and aniline. Water instead of hydrogen sulphide is evolved.

9. The hydrogen sulphide reduction product of *p*-nitroso-dimethyl-aniline reacts with sulphur to form ammonia, H_2S and a purple dye.

Cement Experiments

10. *Cement Experiments*—The base stock consisted of pale crepe 100, zinc oxide 10, sulphur 6. The cement was made up of 10 g. compound plus 108 g. of benzene; 118 g. of the cement was placed in each bottle. In many cases an equal or greater weight of accelerator than the actual weight of compound present was added. This was done in order to bring out weak curing action and to speed the experiments.

a. Aniline produced no action.

b. Ten g. of a mixture of aniline 93 g. and CS_2 38 g. caused a gelling or curing of the cement in twenty hours.

c. 5.3 g. *o*-toluidine + 3.8 g. CS_2 duplicated the above in twenty hours.

d. The same amount of *p*-toluidine and CS_2 as above did it in eighteen hours.

e. *p*-Phenylene-diamine and CS_2, and beta-naphthylamine + CS_2 did not gell the cement in two months.

f. Thiocarbanilide and aniline (11.4 and 4.1 g. respectively) did it in ten days. NaOH, CS_2, PbO, piperidine in place of aniline were not successful activators. No action was noticed within two months.

g. *p*-Nitroso-dimethyl-aniline, either alone, treated with CS_2 or with H_2S, had no action within two months. But treated first with H_2S and then with CS_2, the cement gelled in six days. Nitroso-phenol treated in the same way also gelled the cement.

h. Sodium ethyl xanthate produced a thin gel in sixteen days and a thick one in thirty days.

i. Zinc ethyl xanthate produced a gel in twenty-four hours.

j. Thiophenol and thiophenol + CS_2 produced no action in two months. But zinc thiophenol caused auto-vulcanization in twenty-four hours.

k. Mercapto-benzo-thiazole caused gelling in seven days, while zinc-mercapto-benzo-thiazole did it in forty-eight hours.

l. The entire experiments were repeated in a pure gum cement, without the zinc oxide. Only the three zinc salts, zinc-ethyl xanthate, zinc thiophenol and zinc-mercapto-benzol-thiazole, gave positive results. These three compounds and the bases from which they are derived (mercapto-benzo-thiazole, etc.) are also excellent accelerators for heat curing of rubber.

Summarizing then, the function of zinc oxide seems to be in the formation of organic zinc salts with the accelerators. These zinc salts are probably the true polysulphide formers. That such zinc salts do exist Mr. Bedford has demonstrated.

Reports of Committees

Abstracts—Arrangements have been made with the trade papers to carry any articles the division wishes published.

Accelerators—About fifteen accelerators are now on the books of the secretary and the members of the Rubber Division can secure the composition of these by writing him.

Physical Testing—The old committee was discharged and the following men appointed on a new committee: Messrs. North (Goodyear), Wiegand (Ames Holden MacCready), Collier (Bureau of Standards), Grafton (Quaker City) and Simmons (Akron University).

Division of Physical and Inorganic Chemistry

The schedule of this division was too ambitious, having almost three times as many papers as the average group at the meeting and dividing the time for presentation and assimilation into insufficient periods. At least forty of the sixty-five papers should have been read only by title, giving the important contributions time for detailed consideration.

The fifteen papers in the Symposium on Contact Catalysis in themselves brought out nothing extraordinary in the way of ideas and were exceeded in value by the discussions of Messrs. Langmuir, Taylor, Forbes, Fink, Weiss and Bancroft. Dr. Langmuir introduced the idea that the boundary between the two phases of the catalyst probably located the zone where the reaction takes place. In the equilibrium between the metallic and oxide phases of copper or nickel ideal conditions from the point of view of the oscillation theory are to be had for catalysis. Without this boundary phase, no appreciable reaction takes place, so that this conception promises at least to augment if not entirely supersede the long-honored adsorption theory. However, the experimental work of the investigator is made even more difficult by this conception, especially if he attempts to make quantitative measurements on anything other than the velocity of his catalyzed reaction. A survey of phase boundaries doesn't seem to be even a remote possibility and even if it were, there is no reason to believe that the activity would be equally distributed over the more or less accessible areas between the two phases. The removal of water of crystallization from salts in a desiccator is not usually thought of as a catalytical phenomenon, but it has been proved to be such, the presence of both the hydrous and anhydrous phases being essential before the water goes off under normal conditions. Superheat or a scratch will induce the latter phase. The same phenomenon takes place in the calcination of limestone. Copper oxide is not reduced by hydrogen until metallic copper is formed and the reaction takes place at the location of the contact between the metal and oxide.

High-Temperature Nickel Inactive

When nickel catalyst is heated above 600 deg. C. it gradually falls off in hydrogen adsorption, becoming inactive at 1,000 deg. C. R. M. Burns and H. S. Taylor presented curves showing measurements made at Princeton. In studying copper it was found that the hydrogen adsorption was very low. A physical study of all the hydrogen catalyzers is being made in their laboratory and detailed attention is being given to the phase systems and catalyst surfaces.

In the discussion Irving Langmuir pointed out that the electron may be an important factor, present theory of valence and chemical combination indicating that molecules are held together by electronic forces. John Morris Weiss drew attention to the lack of knowledge of what temperatures exist at the surface of the catalysts and suggestions were made that they be calculated from reaction heats or measured by fine platinum resistance wire. It is rather doubtful if any useful result can be obtained by such methods.

Influence of Agitation on Reaction Velocity

R.p.m.'s as a catalyst formed an interesting contribution by C. H. Milligan and E. Emmet Reid. Whether every influence that increases the velocity of a reaction is to be taken as catalytical phenomenon is a disputed question. Most chemists prefer to class mass, temperature, concentration and agitation in a category by themselves. The authors observed that with agitation at 1,000 r.p.m. benzene absorbed 80 c.c. of ethylene per minute, forming ethyl benzene and at 13,000 r.p.m., 1,790 c.c., the same conditions of saturation being taken for comparison. Final saturation produced hexa-ethylbenzene.

Catalytic Combination of Hydrogen and Oxygen

R. N. Pease and H. S. Taylor reported their study of the influence of reduced copper oxide catalyst on the reaction of hydrogen and oxygen mixtures below combustion temperatures. The stability of copper oxide in hydrogen at 150 deg. C. was found to be very great, no reduced copper appearing until after four days, when a small spot appeared. The presence of 2 per cent water or oxygen prevents the formation of any reduced copper. In the catalytical reaction between the hydrogen and oxygen, the boundary phase between the oxide and metal is accepted as the location of the catalytical effect, giving a fluctuating equilibrium.

In the production of hydrogen from water-gas considerable trouble is had in obtaining a product free from carbon monoxide. N. A. Neville and H. S. Taylor have worked on a reaction using potassium carbonate as a catalyst, whereby carbon dioxide is obtained at temperatures around 500 deg. C. An explanation of the phenomenon cannot be had by simply assuming that the salt absorbs carbon dioxide and thus induces its formation. Perhaps its effect on the carbon itself in maintaining temperature and surface uniformity induces the reduction of the gaseous water by the carbon monoxide.

Oxidation and Reduction in Copper Cells

In refining copper in electrolytic cells a large part of the current is ordinarily spent in oxidation at the graphite anode and reduction at the cathode, if iron sulphate is present in the electrolyte. Colin G. Fink reports that if ferrosilicon anodes are used, the phenomenon ceases, indicating that there is some inherent property in graphite, perhaps oxy-graphite, that catalyzes the oxidation pheonomenon and prevents oxygen being given off at the anode.

Low-Temperature Brin's Reactions

James Kendall and F. J. Fuche have recently found that mixed oxides of silver, mercury and barium yield their peroxides at very much lower temperatures. Sufficient work has not been done to tell if the effect were partial or complete and if the reaction will be valuable in making a modified Brin's process for the separation of oxygen from air.

Structure of the Ice Molecule

Dennison has recently shown by X-ray crystal analysis that ice consists of two water mols with the electrons arranged in a hexagonal packing. A structure was proposed by Irving Langmuir in which the nuclei of the four hydrogen atoms hold by their fields of force the two oxygen cube atoms, the hydrogen electrons filling the shell of the oxygen atom and the nuclei being sandwiched in between.

Purification of Helium

When helium becomes loaded with air after it has been in use through diffusion of the latter through the balloon fabric, it can be purified by a process recently developed by Leo Finkelstein and C. B. Seibel. The mixture is cooled below the critical temperature of nitrogen and filtered through adsorption carbon, which takes up both the oxygen and nitrogen. The refining plant is mounted on two railroad car trucks and can be moved to the various aviation fields.

Influence of Gelatin on Transference Number of H_2SO_4

Alfred L. Ferguson reported a correction in the transference number of sulphuric acid, now in the literature as 0.177, the new determination being 0.1868 at 25 deg. C. In studying the influence of gelatin, it was found that the gelatin formed a true salt with the anion and changed the transference due to the low velocity of this complex cation. The concentration cell method was used with the formula:

$$E = \frac{2 - 3n_a}{2} \frac{RT}{F} \ln \frac{c_1}{c_2}$$

The Alkalinity of Searles Lake Brine

The alkalinity of the brine at Searles Lake is due to the weak acid soda salts: the carbonates, bicarbonates, borates and metaborates. The total CO_2 content averages around 1.84 per cent and the B_2O_3 1.04 per cent. In order to determine the salt composition, the p_H curve of each salt was determined, from which it was possible to calculate the composition from the hydrogen ion concentration of the raw brine.

The Vapor Density of Technical Phosgene

Phosgene constants were reported by F. O. Germann and Vernon Jersey, the boiling point being 8 deg. C., vapor pressure at zero 552 mm. and the vapor density 4.5263 g. per liter. It was observed that the rate of hydrolysis was proportional to the wet surface area. When the phosgene was passed over wet glass beads, the hydrolysis was instantaneous, while if water was poured into the liquid phosgene, the reaction proceeded only at the interfilm.

Chromatic Emulsions

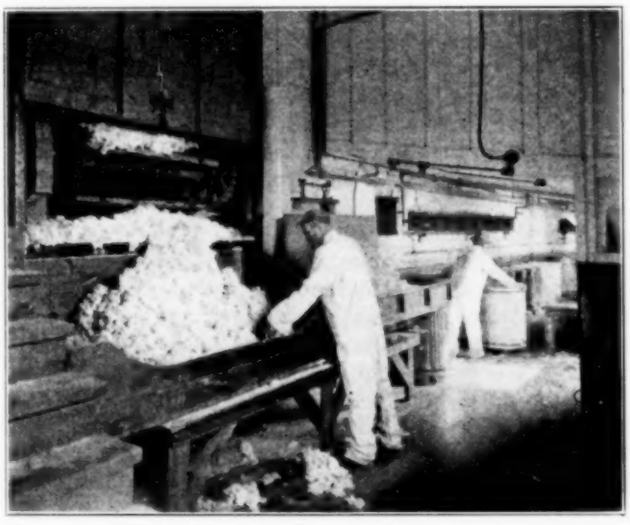
Chairman Harry N. Holmes entertained the division with experiments on the dispersion of light into its color elements by transmission through globules formed by digesting glycerine, water, amylacetate, benzene and pyroxylin into an emulsion. The size of the particles did not appear to be a factor, but the glycerine concentration was important. The pyroxylin stabilized the emulsion, forming a strong film surface around the globules. In daylight the dispersion effect is lost due to the mixing of the rays, but with light from a single source the phenomenon is very beautiful.

Kodak Park Works

Kodak Park, the largest of the five Rochester establishments of the Eastman Kodak Co., is a park of 225 acres situated just within the northerly limits of the city. Eighteen of these acres are laid out in trees, shrubs and lawn. Its principal products are photographic film and papers, dry plates, chemicals and developers. Factories are also maintained for the manufacture of raw paper, gelatine and acids (nitric and sulphuric) for nitrating purposes, also for the manufacture of wood, paper and fiber boxes, cartons, tin containers, film spools and wood parts for cameras. Steel and concrete buildings to the number of 114, representing an additional floor space of over 80 acres, have already been erected for the manufacture of these various products.

Film Capacity

Some conception of the extent of Kodak Park and the various ramifications of the photographic industry it contains may be gathered from the fact that the output in motion picture film alone for last year was over 50,000,000 ft. per month or, roughly, 125,000 miles for the year. Into the manufacture of this and other film goes nearly 3,000,000 lb. of cotton per year, and into the sensitizing of Eastman products over three tons of pure silver bullion every week, or one-twelfth of all the silver mined in the United States.



COTTON DRIER

Power and Light

Power and light are furnished by two turbine and four engine-driven electric generators, with a total capacity of 4,500 kw., or 6,000 hp. Another 2,400 hp. is furnished by the Rochester Railway & Light Co.'s plant; 2,250 motors are required to operate the machinery in the buildings. The power house contains twenty-two boilers with a total (rated) boiler capacity of 7,800 hp.

Above the boilers are the coal bunkers, with a capacity of 3,200 tons. From these the coal drops through chutes to mechanical stokers at the rate of upward of 400 tons per day. Waste gases from the furnaces pass through fuel economizers and ashes are removed by a mechanical conveyor.

Two chimneys, which tower above the power house and dominate the landscape for miles around, have a

NITRATING SILVER

combined capacity equal to 20,000 boiler horse-power. Each is 366 ft. high; one measures 28 ft. at the base and 11 ft. at the top, and the other 31 ft. at the base and 15¼ ft. at the top. These chimneys were built high to carry off any possible fumes from nitration.

Refrigeration Plant

As moisture or variation of temperature would be fatal to uniform film quality, the great rooms in which film is sensitized and handled are kept at even temperature by a constant supply of cold air. Refrigeration for this purpose is maintained by six ammonia compression machines of 2,650 tons capacity, and twelve ammonia absorption machines of 1,700 tons capacity, a total of 4,350 tons—sufficient for a city of 200,000 people. A fire department is maintained with 150 trained men under the direction of a chief and two deputy chiefs. They live in close proximity and are available at all hours. The fire equipment includes a White motor truck, chemical engine, three hose carts, hook and ladder truck, salvage and tool wagons, pulmotors, smoke helmets, diving suits and all the minor paraphernalia attaching to such equipment. In addition to this, twenty-seven hose houses are located over hydrants outside various buildings, each equipped with 250 ft. of 2½-in. hose.

Water Supply

The works have an inexhaustible private water supply system connected directly with Lake Ontario, six miles away. A pumping station on the lake shore, with a capacity of 16,000,000 gal., pumps the water through a 24-in. main to a 5,000,000-gal. reservoir in the park. The pumping station there, with a capacity of 12,000,000 gal.—sufficient to supply a city of 150,000 population—maintains a pressure of approximately 100 lb. throughout the park. A steel tank with a capacity of 150,000 gal., built 150 ft. above the reservoir, and two auxiliary fire pumps with a capacity of 1,000 gal. each, are additional fire precautionary measures. Sixty-eight hydrants and four miles of 6, 8, 10, 12 and 16-in. mains gridiron the works.

Welfare Work

The attitude of the company toward its many thousand employees is reflected in the numerous provisions for their comfort and physical well-being. These begin with park surroundings; they include lunch facilities, recreation grounds, medical service, dental service, reading and rest rooms, and all the other welfare features of a modern industrial plant.

Research Laboratory

Picture making has been made the simple pastime it is only because the results of careful investigation into the behavior of photographic products have been transferred with equally scientific exactness to the sensitive materials employed. The right arm of the photographic industry is consequently the laboratory, and the company maintains one of the most completely equipped and best staffed industrial laboratories in the world.

The laboratory building itself is 80 ft. square, three stories in height, and employs a staff of one hundred and twenty. In addition to testing laboratories, X-ray rooms and studios, the building is equipped with an independent plant for the manufacture of photographic material on such a scale that the results can be practically applied in the manufacturing departments. Here also are made the photographic materials required for scientific work, for which, of course, there is little or no commercial demand. There is no attempt to limit laboratory investigation to purely practical ends, and the results obtained are available for publication in the same way as university and government laboratories publish theirs.

Photographic Library

A large photographic library, in charge of a trained librarian, is maintained in connection with the laboratory. Practically every important photographic work in English as well as in foreign languages may be found among the 6,500 volumes on its shelves. A large number of books and magazines on kindred subjects are also included.

Film Making

The first process in film making consists in thoroughly washing cotton with caustic soda to remove vegetable gum and other impurities. This is done in large rotary vats. To eliminate moisture the cleansed cotton is then passed through huge driers. It is then "treated" with a mixture of nitric and sulphuric acid to produce cellulose nitrate. Nitrating centrifugals are used for this process. These machines consist of "perforated baskets" rotating inside a vat. The cleansed cotton is fed into the basket and acids are let into the vat until the cotton is immersed. The acids are then immediately drawn off and the basket is rotated at high speed for draining.

SILVER BULLION (KODAK PARK USES ONE-TWELFTH OF ALL THE BAR SILVER PRODUCED IN THE U. S.)

NITRATING COTTON

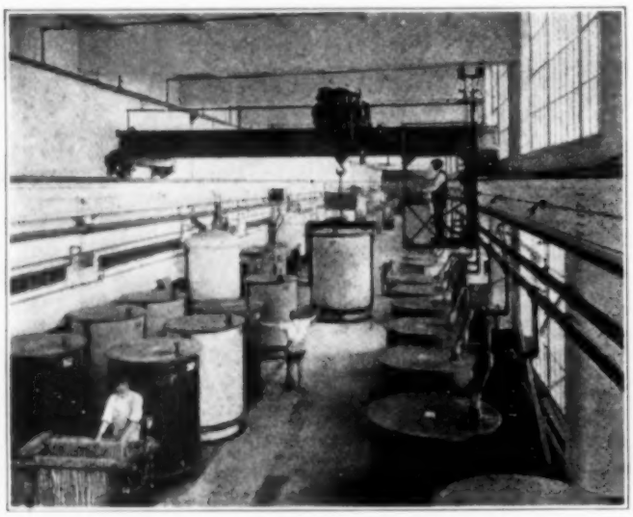
To remove every trace of acid, the nitrated cotton is then put into huge washing machines, which are a combination of washing machine and wringer. The construction is similar in principle to the nitrating centrifugals. The nitrated cotton contained in perforated baskets is immersed in vats of water, and the water drained off after each rinsing. The wringing is done by rotating the baskets at high speed. These washings are repeated for several weeks.

Film "Dope"

Washing and drying completed, the nitrated cotton is ready for the solvents. These solvents are run into "mixers" and the cotton is fed into them through chutes. In the mixers—sometimes called dough machines—large paddles churn the cotton and solvent together thoroughly. When thoroughly mixed, the solution is a viscous liquid called "dope."

This "dope" is piped to large air tight tanks, where it is kept ready to be converted into sheets. This is done on what are known as coating machines. An elaborate system of filters spreads the mixture evenly on highly polished wheels, where it forms a sheet 3½ ft. wide, 2,000 ft. long and 0.005 in. thick.

This sheet, when dry, becomes the familiar transparent film backing or base on which the sensitized coating is spread. The accuracy of these machines is such that the variation in thickness of a sheet from end to end, when coated, is not more than the $\frac{1}{2,000}$ part of an inch.



DOPE TANKS

Silver Nitrate

Silver is the active element in the light sensitized material with which film is coated. Pure silver bullion is first dissolved in diluted nitric acid to form silver nitrate. When evaporated, this is reduced to white crystals, which are carefully washed and redissolved until all trace of impurities is removed. The pure silver nitrate crystals are then placed in trays, a thousand ounces to a tray, and stored in aluminum drying closets.

The compound sensitive to light, known as silver bromide, is formed by mixing these nitrate crystals with potassium bromide and gelatine, dissolved in hot water. This gelatine solution, known as the "emulsion," is spread on the film in emulsion coating machines. This coating is, of course, a dark-room operation, as is the mixing of the "emulsion" itself.

From the slitting machines the film goes to the spooling room, where it is wound on cartridges. Motion picture film is reeled in 200 and 400 ft. lengths, and when so spooled and packed is ready for shipment.

Excursions were made to other plants, including the Taylor Instrument Cos., Pfaudler Co., Bausch & Lomb Optical Co., Rochester Gas & Electric Corporation, Bastian Bros., Vacuum Oil, Bartholomay Co. and the municipal disposal plants.

Exhibits at Mechanics Institute

One of the pleasing sidelights of the meeting was the number of exhibits of local manufacturers shown in the hallways at Mechanics Institute, where the convention divisional meetings were held. The R. J. Strasenburgh Co. showed a case of standardized pharmaceuticals. The Pfaudler Co. exhibited special pieces of glass-lined apparatus including condenser, enameled steel agitator, enameled kettles, reducing ell and observation glass for viewing the interior of a tank containing liquid.

Grahame Chemical Co., of Rochester and Liverpool, England, showed a complete set of apparatus for hydrogen ion determination together with a series of indicators to be used. The Taylor Instrument Co. of Rochester had a large glass showcase in which were displayed the Tycos line, including thermometers, hydrometers, recording instruments, compasses and the cyclo-stormograph.

By far the largest exhibit was a very complete layout of scientific apparatus handled by the Will Corporation, with headquarters in Rochester. This included the complete line of the products of the Torsion Balance Co., in charge of A. T. Millroy; a glass-blowing exhibit in charge of Frederick Kraissl, of the Corning Glass Works. Numerous pieces of pyrex glass were formed by the blowers. Christian Becker, Inc., had a section displaying balances and weights of precision. W. B. Valentine was in charge of the section for the Valentine-Abbe Refractometer which was on exhibit.

Other displays by local concerns of varying interest to the chemists were a case of organic chemicals manufactured by the Eastman Kodak Co., optical measuring instruments produced by the Bausch & Lomb Optical Co., samples of Filtros by the General Filtration Co., forgings and castings by the General Railway Signal Co., motors by the Northeast Electric Co., and telephones by the Stromberg-Carlson Co.

Symposium on Corrosion of Metals and Alloys

Copper-Bearing Steel and Perhaps Steel With Other Alloying Elements Resist Atmospheric Corrosion Better Than Ingot Iron, But the Latter Excels When Immersed in Water—Oxygen and Carbon Dioxide Cause Most Damage in Steam and Hot-Water Piping

ALTHOUGH the problem of corrosion is one of the oldest that has confronted engineers, it is only within the last generation that the problem has been very seriously considered. There has been an ever-increasing use of steel and sheet metal in construction, and new and special alloys have been introduced for a host of modern-day mechanisms and devices. Bridges, ships, roofs, agricultural machinery, telegraph and trolley poles, conveyances, storage tanks, etc., all of which were formerly constructed of wood, are now made of steel or iron. The keynote of the Electrochemical Society Symposium was the emphasis on the practical side of the problem. While some of the papers dealt with the question of producing a corrosion-proof metal or alloy, other papers covered tests on simple methods to protect the metals now available.

For the sake of convenience and aside from any scientific basis we may classify the various corrosion studies under the following headings:

1. Corrosion of metal roofing—atmospheric corrosion.
2. Corrosion of pipes, rods, wires, imbedded in moist soil.
3. Corrosion of boiler tubes and hot-water pipes (closed systems).
4. Corrosion of metals submerged in sea water or acid liquors.
5. Corrosion of metallic anodes.

There is another type of corrosion met with in the case of metal electrodes in vacuum apparatus such as audions, Moore tubes, cathode ray tubes, etc., which, however, though similar in many respects, is usually not classified as corrosion, since oxygen and moisture are practically absent or play but a secondary rôle.

In all of the above five cases corrosion is of the electrolytic type, the electric current being produced either (1) by local couples composed of two or more different constituents in the same metal or alloy; (2) by a couple formed by the union or contact—immediate or distant—of two entirely distinct metals or alloys (as for example, a copper sign plate attached to a steel-re-enforced-concrete wall); (3) electrolytic action may be due almost entirely to stray currents from neighboring service lines; or (4) the electric current may be intentionally applied, as in the case of anodes in acid liquors.

Copper-Steel Exposed to the Atmosphere

Of the iron and steel papers presented at the symposium almost every one of them took up the question of the effects of small copper additions. D. M. Buck of Pittsburgh[1] carried out large-scale tests at Scottdale, Pa., extending over a period of about three years on 16-gage iron sheets, containing various percentages of copper and exposed simultaneously to the weather. In general, Buck finds that the addition of small percentages of copper reduces the corrosion rate very markedly, as compared with that of ordinary iron, under conditions where the product is alternately wet and dry. For example, after thirty-two months' exposure to the atmosphere the sheets containing 0.01 per cent Cu lost 33 oz. per sq.ft., those with 0.018 per cent Cu lost 23 oz., and those with 0.2 per cent Cu lost but 6 oz. Buck finds that after some months exposure a firmly adherent film is formed on copper-steel which cannot readily be removed with a wire brush. Some idea of the thickness of this film was obtained by first weighing, then scratch-brushing the samples and weighing again, and then removing the tenacious scale with an ammoniacal solution of ammonium citrate and weighing once more. In this manner very concordant results were obtained indicating that after eight months' exposure the closely adherent scale weighed 2.3 to 2.4 oz. per sq.ft. and at the end of thirty-two months 2.8 to 2.9 oz. The closely adherent scale can therefore be figured to be 0.12 to 0.15 mm. thick. Buck also found that steel carrying 0.03 per cent S requires at least 0.07 per cent Cu, and steel carrying 0.055 per cent S 0.12 per cent Cu. He concludes that the inhibition of corrosion through the addition of copper may be accounted for in two or more ways. The harmful influence of sulphur on corrosion is in some manner controlled by the copper; furthermore, the dense film which is formed on copper steels is a real and efficient protector of the underlying metal.

E. A. Richardson of Cleveland pointed out that Buck's curves show that the dominant factor in the decreased corrosion of copper-bearing steels is the composition of the metal itself and that the adherence of the rust coating is a secondary factor. William H. Walker of Boston referred to tests that indicated that copper-steel produces its own protective covering only when the oxygen concentration is high. When the amount of oxygen is limited, as when the structure is immersed in water, corrosion proceeds comparatively rapidly. L. T. Richardson of New York concludes from Buck's tests that the rate of corrosion appears to be influenced mainly by the composition of the metal surface exposed.

O. W. Storey of Madison, Wis., made a careful study of the report of the American Society for Testing Materials and finds that copper-steels made by the acid process which were high in phosphorus were much more resistant to corrosion than low-phosphorus copper-steels made by the basic process. This finding checks up with conclusions drawn by Buck some time ago. This phase of the subject is, however, not definitely solved. It may be that the addition of phosphorus to some of the pure irons or low-phosphorus basic open-hearth steels will have a favorable influence and make them as resistant to corrosion as the acid open-hearth or bessemer copper-steels are at present. The sheets that Buck reported upon were basic open-hearth of an unpublished phosphorus content.

[1] Observations on the Mechanism of the Increased Corrosion Resistance of Steel and Iron Due to Small Copper Contents.

E. A. and L. T. Richardson[2] investigated samples of iron that have resisted atmospheric corrosion for upward of thirty years. Those samples containing 0.1 per cent copper or more were in good condition, whereas those that were free from copper or contained but traces were in poor condition. This confirms Storey's results on tests of eighty different fence wires. The wires which were in better shape always contained Cu. A. S. Cushman of Washington maintained that the evidence was not complete to attribute the resistance to corrosion of the fence wires to the presence of copper; there are other factors that must be taken into account.

T. S. Fuller[3] of Schenectady described simple tests which closely correspond to atmospheric tests but can be readily carried out in the laboratory. Progressive placing of drops of water on the same spot of a sheet of metal and allowing each drop to evaporate before adding the next one showed that the first drop was much more "corrosive" than subsequent drops, indicating that a partial immunity is built up. The activity of the first drop is three times that of the second drop. Ordinary cold-rolled iron corroded more than iron containing 0.29 per cent Cu, and this in turn corroded more than iron containing 2.57 per cent Cu. According to Fuller's test one can determine relative resistance to corrosion in a day in the laboratory as well as with a year's test in the atmosphere. Fuller agrees with Storey and others that there are very likely other metals or elements besides copper that retard corrosion when added to steel in small quantities.

Copper-Steels Exposed to Products of Combustion

Storey suspended samples of steel, with and without copper, in the stove flues in households in different sections of the country. He found that steels with about 1 per cent copper are three times as resistant to the combined action of the products of combustion and the alternate heating and cooling of a range as steels with but 0.06 per cent copper.[4] Aupperle does not agree with these tests, and finds that pure iron lasts eight times as long as copper-steel in hot flues.

Copper-Steel in Water and in Electrolytes

A. S. Cushman and G. W. Coggeshall[5] look upon the atmospheric test as covering only a special set of conditions, which are not comparable to most of the conditions of service. They believe that the only reliable test is the immersion test. Samples cut from three sheets of the following composition were tested:

Sheet	C	Mn	S	P	Cu	As
K	0.04	0.29	0.038	0.077	0.20	0.015
C	0.011	0.032	0.039	0.055	0.251	0.102
A	0.011	0.015	0.038	0.006	0.038	0.012

The K and C samples corroded rapidly, as compared with A samples, in solutions of bichromate, aluminum sulphate, aluminum chloride, cold hydrochloric acid and dilute nitric acid; on the other hand, in sulphuric acid and in concentrated nitric acid the samples K and C with the higher copper content stood up better. In general, Cushman and Coggeshall find that "wherever and whenever copper as an alloying constituent in steel does not show itself to be inert, it shows itself to be deleterious and in some cases dangerously so." Buck admits that the protective surface film can be removed by electrolytes; he used ammoniacal solutions of ammonium citrate. The fact, however, remains that copper-bearing iron and steel are more resistant to atmospheric corrosion than copper-free iron or steel.

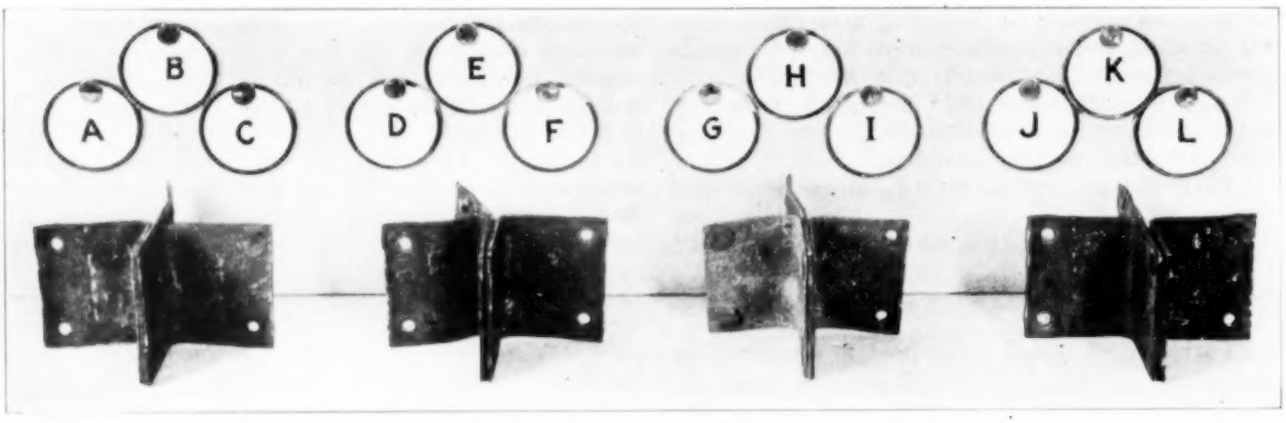


FIG. 1. CORROSION OF IRON AND STEEL WITH AND WITHOUT COPPER, HELD TOGETHER IN VARIOUS COMBINATIONS BY COPPER RIVETS

Aupperle and Strickland[6] likewise conducted immersion tests in a solution containing 0.7 per cent sulphuric acid, 2 per cent ferrous sulphate and 0.15 per cent ferric sulphate. The solution was kept in circulation by means of an airlift. The test lasted sixty days: Commercially pure iron with but 0.018 per cent Cu lost 0.380 oz. per sq.ft., as against 0.430 oz. for 0.304 per cent copper-iron and 1.213 oz. for 0.340 per cent copper-steel. Samples of copper-steel that had withstood atmospheric corrosion for a number of years subsequently lost several times as much weight in the immersion test as did the pure iron samples which failed first in the atmospheric test. Furthermore, when dissimilar metals are used for the construction of tanks, boilers, pipes, etc., and when such metals are in contact with water containing ferrous sulphate and sulphuric acid, the iron or steel containing the most copper will be the first to fail. Such tests are illustrated in Fig. 1.

Oliver P. Storey and H. C. Knapp of Madison, Wis., took samples of ordinary sheet iron, 0.25 per cent copper-steel and commercially pure iron and immersed them in dilute sulphuric acid.[7] The tests were then repeated except that 0.1 to 2.5 g. of copper was added

[2]The Corrosion of Old Iron.
[3]Experiments on the Corrosion of Iron and Steel.
[4]The Corrosion of Steel Ranges.
[5]Anomalies Encountered in a Study of Immersion Tests of Iron and Steel.
[6]Observations on the Corrosion of Iron and Steel.
[7]The Effect of Copper and Silver Salts on the Corrosion of Iron by Acids.

to the electrolyte as copper sulphate. It was found that corrosion was from three to five times as severe in the presence of the copper salt irrespective of the copper content of the sample.

In comparing the immersion tests of Cushman, Aupperle and others on copper-iron and copper-steel with the atmospheric corrosion tests of Buck, Fink suggested that the difference between the two tests was largely one in degree. By the acid immersion test we bring about results which may take very many years to obtain by mere exposure of the samples to the weather. This view is supported by Buck's findings as recorded

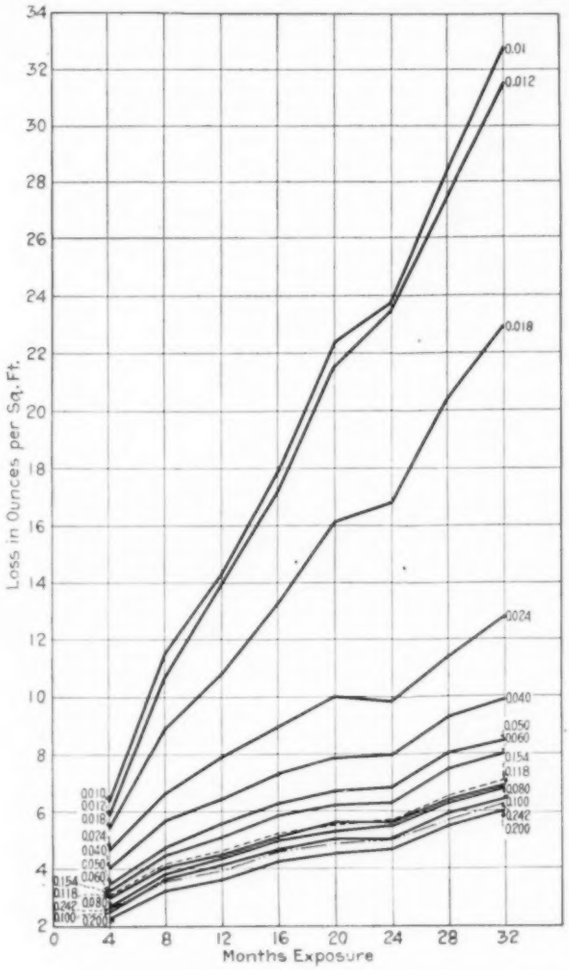


FIG. 2. LOSSES ON SPECIMENS CLEANED WITH CITRATE

in Fig. 2. The addition of copper merely reduces the rate of corrosion; throughout the life of the sheet, the rate is practically constant. Thus, for example, sheet iron with but 0.01 per cent Cu will corrode at the rate of 1 oz. per month per sq.ft. of metal exposed as compared with one-fifth of an ounce per month for sheet iron containing 0.20 per cent Cu.

The Ferroxyl Test

This test, which has been repeatedly described in the literature, and which consists of imbedding small steel or iron samples in gelatine saturated with ferricyanide and phenolphthaline, is decidedly simple and very instructive. Cushman reproduced on the screen a series of very interesting tests made on iron nails. A photograph of one of these tests is herewith reproduced. (Fig. 3.) This is unusually attractive on account of the distinct lines (dark blue in the original) which

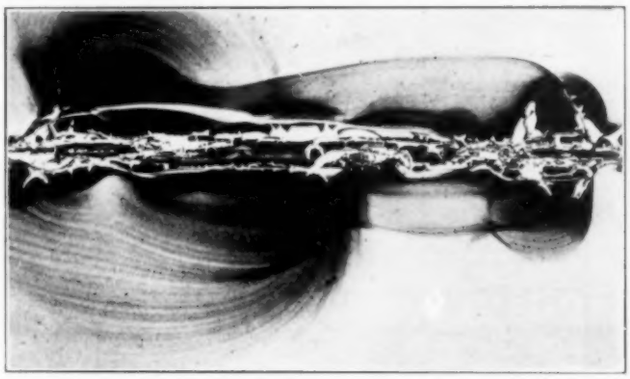


FIG. 3. FERROXYL TEST. A. S. CUSHMAN

have all the appearance of "magnetic lines of force." J. W. Richards and Cushman were of the opinion that these lines are due to electrolytic action; W. C. Moore, however, maintained that the lines were merely due to diffusion. The point is not definitely decided and further investigation would appear well worth while.

Practical Means of Preventing Corrosion of Boiler Tubes and Hot Water Pipes

F. N. Speller, of Pittsburgh, finds that in the case of boiler tube and hot water pipe corrosion, the destructive element is oxygen.[8]

Besides oxygen, carbon dioxide may be the direct cause of boiler tube corrosion.[9] Worth found that the cause of rapid corrosion of a boiler at a Keport plant was attributable to the presence of soluble bicarbonate of iron in the supply water. Upon heating, large quantities of CO_2 were evolved. The water was then treated by being kept at the boiling point for eight hours in a preheater, where the carbonic gas was liberated and a sludge of ferric hydroxide precipitated. The corrosion trouble then ceased.

Paint as a Non-Corrosive Film for Iron and Steel

H. A. Gardner[10] recommends that paints for priming steel should preferably be made of a substantial amount of one or more basic or chromate pigments, and that these paints should be covered with water-resisting finishing coats of carbon or iron oxide. Zinc and aluminum bronzing powders applied direct to steel surfaces possess much greater rust-preventing properties than the powders of other metals. A high-grade exterior spar varnish should be used for suspending the powders.

Corrosion of Buried Lead Cables

The results of E. R. Shepard's investigation on lead cables[11] agree in general with those of McCollum and Ahlborn[12] of the Bureau of Standards. Shepard extended some of these tests at the bureau. The relation between the moisture content of the earth and the coefficient of corrosion[13] is shown in Fig. 4. Curves in Fig. 5 show the coefficient of corrosion for different

[8]Practical Means of Preventing Corrosion of Iron and Steel Where Not Exposed Directly to the Atmosphere. This paper will be published in full in a subsequent issue.
[9]Unusual Boiler Tube Corrosion by Carbon Dioxide, by Barzillai G. Worth.
[10]Metal Protective Paints. This paper will be printed in full in a subsequent issue.
[11]Electrolytic Corrosion of Lead by Continuous and Periodic Currents.
[12]Bureau of Standards Paper 72 (1916).
[13]The ratio of the actual corrosion to that which would have occurred if all of the electrode reactions determined by Faraday's law had been involved solely in corroding the anode.

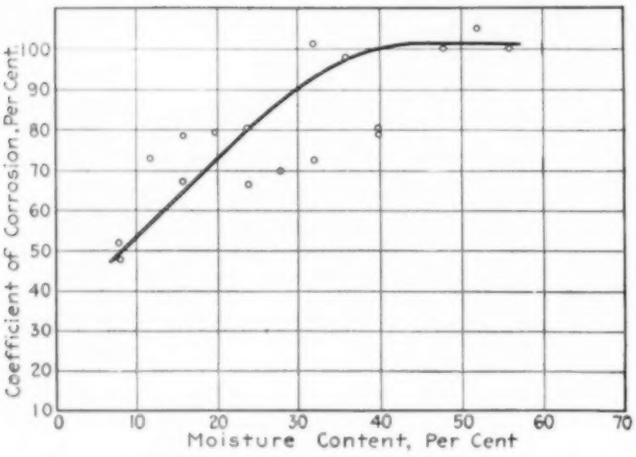


FIG. 4. VARIATION OF COEFFICIENT OF CORROSION WITH MOISTURE CONTENT IN BUREAU EARTH. CONTINUOUS CURRENT, 0.5 M.A. PER SQ.CM.

percentages of the total time the lead test plates were anodic. In other words, with periodically reversed currents the coefficient of corrosion based on the anodic current decreases rapidly with time. With continuous current, the coefficient of corrosion in both tap water and earth decreases with an increase in current density. In reference to the corrosion of lead in sulphuric acid, Bancroft felt that although lead peroxide must go into solution in order that the battery function, on the other hand, the same oxide protects the lead of the grid: One is a loose packing, the other an adherent film.

The Corrosion of Alloys

One of the most interesting and instructive papers of the symposium was that of H. S. Rawdon on "Some Types of Non-Ferrous Corrosion." The author discussed the structural changes caused by corrosion of non-ferrous metals as belonging to four distinct types—namely (*a*) Selective attack of certain constituents. (*b*) Intercrystalline brittleness. (*c*) Internal oxidation. (*d*) Simultaneous action of stress and corrosion. As examples of each type the following are given: Type *a*—Brass (60 per cent Cu, 40 per cent Zn) was exposed to sea water for seven years. The α constituent (65 per cent Cu) was untouched, while the β constituent (50 per cent Cu) was corroded by a leaching

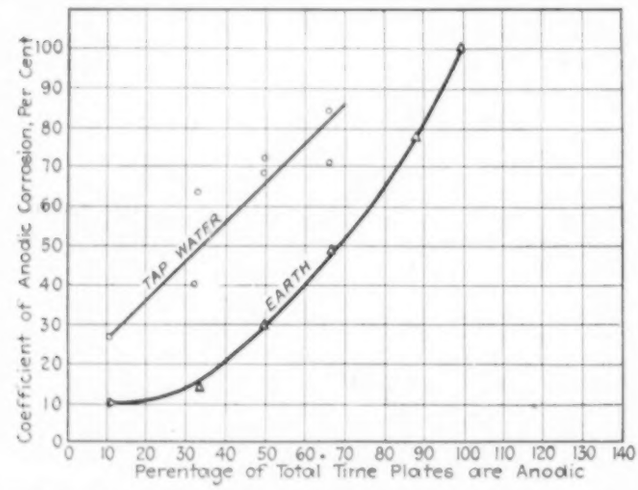


FIG. 5. VARIATION OF ANODIC CORROSION WITH PERCENTAGE OF TOTAL TIME PLATES ARE ANODIC, ON 20 MIN. PERIOD. ±0.5 M.A. PER SQ.CM. TIME 100 HR. SATURATED EARTH AND TAP WATER

out of the Zn, as shown in Fig. 6. Type *b*—Cable sheath of Pb exposed underground became brittle due to the destruction of the intercrystalline material (usually non-miscible impurities such as Fe, Cu, Ni, Zn or miscible eutectic-forming elements as Sn or Sb). This type of corrosion can be induced by immersion in lead-acetate solution. Type *c*—Boiler safety plugs of Sn deteriorated by change of metal to infusible oxide under influence of moist heat. (See Fig. 7.) The same type of change is found with Al-Zn (15 per cent) alloys. In this case moist heat causes the oxidation and swelling of the eutectic matrix. Type *d*—Brass and lead under combined stress and corrosion will fail far below normal stress. This is due to selective corrosion of the β constituent in the former, and to intercrystalline brittleness in the latter.

The foregoing cases of non-ferrous corrosion have been chosen as types to illustrate a few of the many forms in which failure by corrosion may occur.

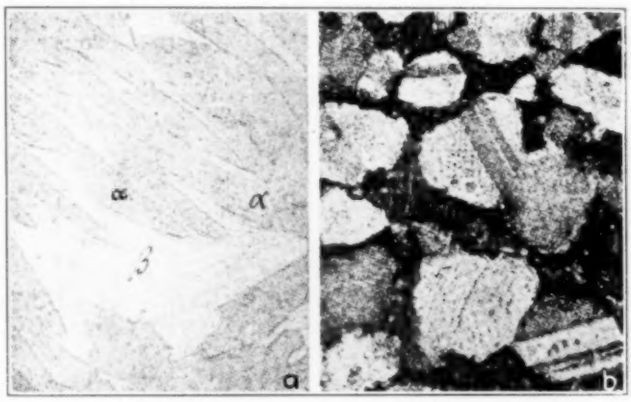


FIG. 6. MICROSTRUCTURE OF MUNTZ METAL SHEET. × 500

a. Microstructure of a Muntz metal sheet showing the two constitutents, α and β. Etching reagent, ammonium hydroxide and hydrogen peroxide.

b. Microstructure of corroded sheet of Muntz metal, after seven years' exposure in sea water; the β constitutent has disintegrated into a weak pulverulent material resembling copper. Etched with ammonium hydroxide and oxidized in the air.

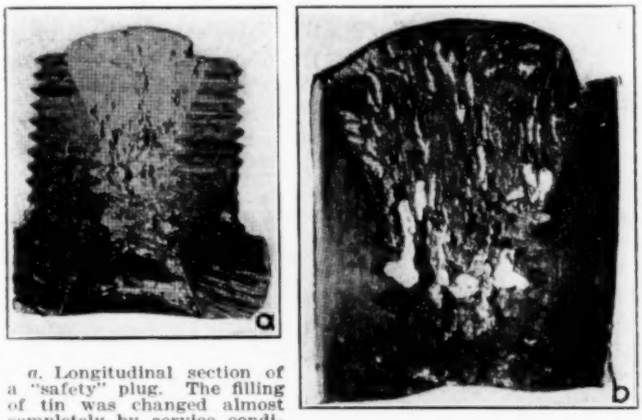
Although the four illustrations have been described as distinct types for convenience, it is quite evident that they are distinct types only so far as appearance is concerned. Fundamentally, they are all very similar.

The increased corrosion due to internal strains or flaws as in the case of the lead pipe will probably account for the failure of the cast iron acid egg which C. L. Fineman reported had been in service for six months for handling mixed nitration acids when it suddenly cracked.

The principles of alloying to resist corrosion appear to Oliver P. Watts comparatively simple. He believes that to increase the resistance to corrosion of any metal there should be alloyed with it another metal which is more resistant to corrosion and which forms a solid solution with the metal whose resistance to corrosion it is desired to enhance. Fink pointed out that the subject was much more intricate than Watts supposed. E. A. Richardson also took exception to Watts' broad generalities. He quoted the case of alloying silicon and iron. Although the two elements form a solid solution and although silicon is much more resistant to corrosion than iron, yet when alloyed with pure iron (say up to 4.5 per cent) resistance of the iron to atmospheric corrosion is materially reduced. The same is true of arsenic and tin when alloyed with iron. John F. Thom-

son shows conclusively in a paper on "A Practical Aspect of the Corrosion Problem" that there are very many factors involved in the selection of an alloy to resist corrosion. Although corrosion resistance is always a necessary factor, it is quite frequently not the determining one which governs practical serviceability. Not only must the chemical factors be taken into account, but also usually the mechanical properties, and very often too the electrical. There is every indication that nickel alloys will be used to much greater extent hereafter.

In closing the symposium, Colin G. Fink summarized the more important points brought out during the two days' discussion as follows: (1) Iron or steel containing about ¼ per cent copper will withstand atmospheric corrosion better than iron or steel without copper. (2) Iron or steel containing about ¼ per cent copper, when completely immersed in ordinary tap water or in acidulated water, does not resist corrosion as well as pure iron. (3) In boiler practice and in hot water systems (closed systems) the presence of oxygen greatly accelerates corrosion; the removal of this oxygen practically eliminates corrosion. (4) Carbon dioxide in boiler water, together with soluble iron, causes corrosion, and the removal of the CO_2 practically eliminates corrosion. (5) Other elements, such as Cr, Si, Ni, Co, etc., added to iron in well-defined amounts tend to reduce corrosion, but detailed investigations have as yet not been reported. (6) A satisfactory co-ordination of alloy corrosion research needed but lacking.



a. Longitudinal section of a "safety" plug. The filling of tin was changed almost completely by service conditions into a hard refractory mass of tin oxide; a few globules of tin may still be seen in the interior. × 1.

b. Portion of *a* after polishing the surface. The white areas are globules of tin which fused when the plug became overheated. × 2.

FIG. 7. STRUCTURE OF CORRODED SAFETY BOILER PLUGS

Fink also made the following suggestions for future study and research: (1) A thorough investigation of the surface film involving careful determinations of the chemical and of the physical properties of this film—e.g., chemical composition, porosity, tenacity, coefficient of adhesion, coefficient of expansion, etc.—as compared with those of the underlying metal. (2) A careful study of the microstructure of the metal near the surface and a similar study of the metal directly underneath the surface film. (3) The effect of chemical and mechanical treatment on the surface film and the underlying metal. (4) A more complete micrographic investigation of the surface changes of metals during the process of corrosion. (5) A better classification of corrosion phenomena—for example, we must define the limits of moisture and salts in air in which the tests were made. (6) A standard of measure of corrosion.

Dye Imports

BY C. R. DE LONG

The following statistics on imports of dyes during 1920 were presented to the Dye Division of the American Chemical Society at the meeting in Rochester April 28. They were prepared by Dr. C. R. de Long, chemist for the U. S. Tariff Commission:

	Lb.	Lb.
Total imports of coal-tar dyes during calendar years 1920		3,700,000
Vat dyes other than indigo		855,000
Indanthrene blue GCD	150,000	
or 18 per cent of total for this class.		
Indanthrene yellow R & G, about 10 per cent total		
Indanthrene black BB, about 10 per cent total		
Bromindigo	34,000	
Ciba scarlet	25,000	
Hydron blue	20,000	
Ciba violet B	18,000	
Mordant and chrome dyes		840,000
Anthracene blue WR	114,000	
or 13 per cent of total for this class.		
Alizarine	73,000	
or 9 per cent of total.		
Brilliant delphine blue BS	29,000	
Eriochrome blue black B	20,000	
Omega brown PB	11,000	
Acid dyes		765,000
Wool green S	127,000	
or 16 per cent of total for this class,		
Patent blue and patent		
Blue A	86,000	
or 12 per cent of total.		
Xylene light yellow 2G and R, about 10 per cent total		
Tartrazine	57,000	
Quinoline	35,000	
Xylene light blue VS	26,000	
Acid violet 4BN	22,000	
Direct Dye		595,000
Zambesi black	about 40,000	
or 7 per cent		
Trisulfon brown B and MB	about 40,000	
or 7 per cent		
Trisulfon brown GG	about 40,000	
or 7 per cent		
Chloramine brilliant	about 23,000	
or 4 per cent		
red 8B	about 23,000	
or 4 per cent		
Pyragol orange G	about 23,000	
or 4 per cent		
Heligoland black	about 23,000	
or 4 per cent		
Sulphur dyes		255,000
Thionol red brown	38,000	
or 15 per cent		
Thionol green DY	24,000	
or 10 per cent		
Basic dyes		200,000
Auramine	85,000	
or 45 per cent		
Phosphine	20,000	
or 10 per cent		
Indigo		171,000

The above figures are approximate, and under each class only the more important dyes have been listed.

Foreign Commerce of Belgium

According to the statistics just published by the Belgian Minister of Finance it appears that the commerce of Belgium in 1920 amounted to 22,495,041 metric tons (1 metric ton = 2,204.6 lb.), of which 11,946,448 tons was imports and 10,548,593 tons exports. This commerce was valued at 19,879,549,000 f. ($1,443,161,451), of which 11,171,467,000 f. ($810,995,789) was imports and 8,708,082,000 f. ($632,165,670) exports. The imports for 1920 exceeded those of 1919 by 5,948,420,000 f. and the exports by 6,419,246,000 f.

Beet-Sugar Project in China

A newly organized Chinese concern named the Pui Chih-Tang Kungsu expects to establish a beet-sugar factory near Huangtaichiao, states an issue of the *Trans-Pacific*. The company's capital amounts to $5,000,000 and is entirely Chinese owned. All machinery and equipment will be imported from America. The capacity of the plant will be about 6,000 tons of sugar a year.

Calculation of Percentage Removal of a Constituent From a Mixture

By W. B. VanArsdel

A VERY common problem in laboratory and plant work is the calculation of the percentage removal of one constituent from a mixture, given the original and final percentages of that constituent in the mixture. Among the instances which might be cited are the following: Recovery of a gas or vapor from accompanying inert gases by passage through an absorption tower; calculation of weight of water to be evaporated from unit weight of a wet material to reduce the moisture content from one specified percentage to another; determination of the proportion of resin or fat recovered by treatment of an oily or resinous material with a solvent. A number of dilution or evaporation charts have been proposed [*cf.*, for instance, Deming, *J. Ind. Eng. Chem.*, vol. 8, p. 265 (1916)], and with slight modifications these might apply to such problems as the second one above; but there seems to be no published work serving just the purpose of the present chart.

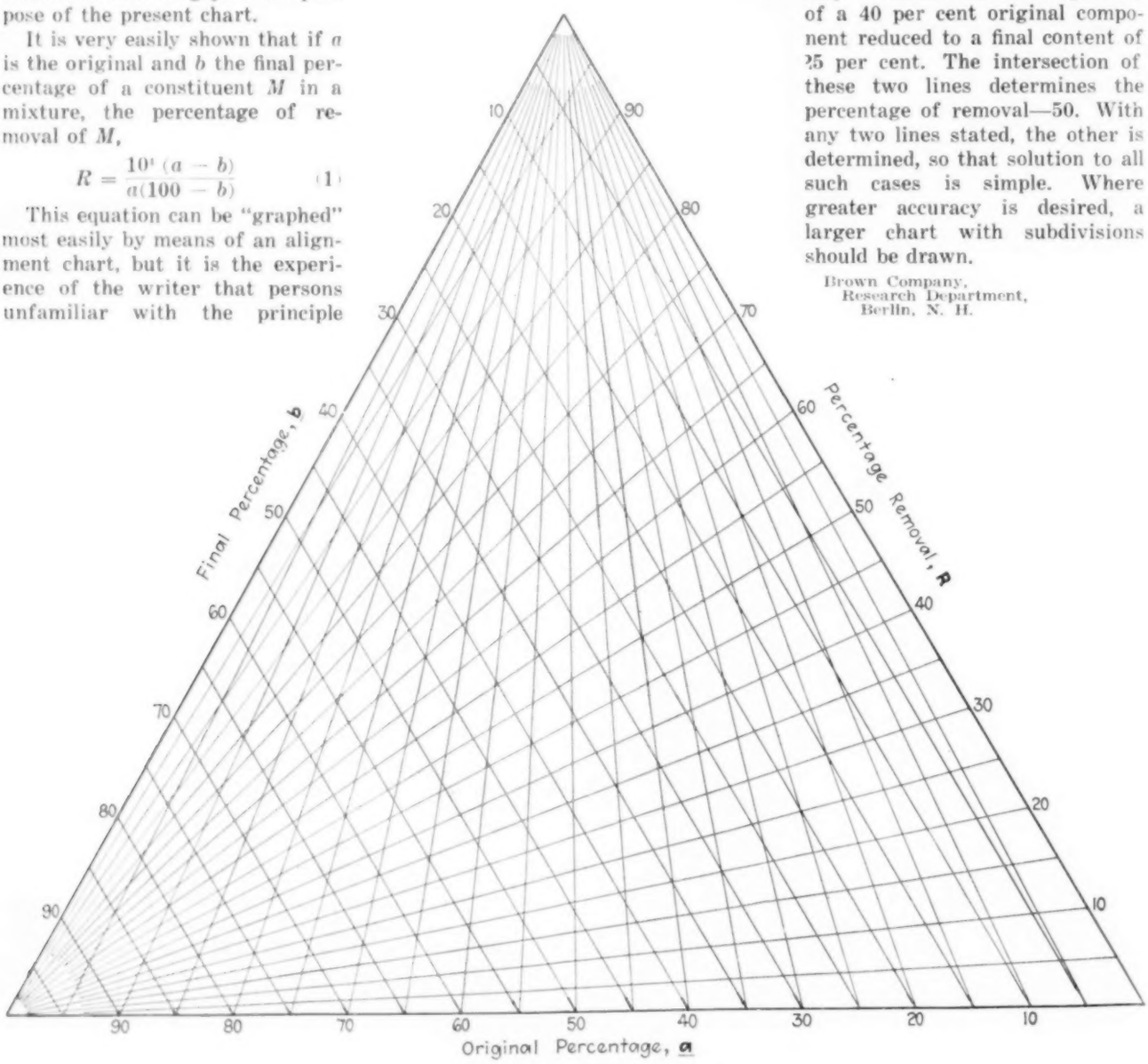
It is very easily shown that if a is the original and b the final percentage of a constituent M in a mixture, the percentage of removal of M,

$$R = \frac{10^2\,(a - b)}{a(100 - b)} \qquad (1)$$

This equation can be "graphed" most easily by means of an alignment chart, but it is the experience of the writer that persons unfamiliar with the principle of the alignment chart use it with hesitancy and are disinclined to use the auxiliary straight-edge required; a network of curves or straight lines, on the other hand, while more difficult to draw accurately, seems to be used with facility. If drawn to a sufficiently large scale, interpolation offers no particular difficulty; in cases where the range of the variables is limited, only a portion of the network need be drawn, and magnification of the units permits greater accuracy of interpolation. In the present case a network of straight lines is set up, covering the whole range from 0 to 100 per cent for each percentage; the accuracy is therefore low when both a and b are very near 0 or 100 per cent. The triangle was made equilateral merely to increase the average angle of intersection of index lines.

It may not be out of place to remark that in the case of a mixture of gases, even if the temperature changes a and b may be expressed in volume-per cent, and R will still represent percentage removal *by weight*. This fact is dependent upon the mixture's behaving according to the simple gas laws and therefore, strictly speaking, excludes vapor mixtures. An example for calculation may be taken from the simple case of a 40 per cent original component reduced to a final content of 25 per cent. The intersection of these two lines determines the percentage of removal—50. With any two lines stated, the other is determined, so that solution to all such cases is simple. Where greater accuracy is desired, a larger chart with subdivisions should be drawn.

Brown Company,
Research Department,
Berlin, N. H.



PERCENTAGE REMOVAL CHART

Behavior of Copper in Molybdenum Ores

Brief Notes on Methods by Which Copper May Be Separated From Molybdenum Ores or Concentrates Previous to Reduction—Precautions to Be Taken in the Analysis for Copper in the Presence of Molybdenum

BY J. P. BONARDI AND MAX SHAPIRO

MOLYBDENUM ores are found that contain copper minerals, in some cases in commercial quantities, the presence of which is objectionable because they are usually carried into the molybdenum concentrates. If these concentrates are to be used for making ferro-alloys or steels they are by some purchasers seriously objected to and penalized, depending upon the amount of copper present. Previous to 1917 copper in molybdenum concentrates was particularly undesirable and its presence in excess of 1 per cent, even in high-grade molybdenite concentrates, was usually sufficient to render the material unmarketable. Some dealers did, however, accept concentrates containing more than 1 per cent copper, but when 4 or 5 per cent copper was present the penalties exacted were such as to be prohibitive. Since then various new methods of ore dressing have been tried out with varying degrees of success, which have to a great measure eliminated the copper content in molybdenum concentrates, so that at the present time the copper content can be kept around 0.5 per cent, and usually less, depending upon the relative proportions in the ore.

Very little exact information is at present available as to the copper limitation placed on molybdenum concentrates; it is generally stated as between 0.2 and 0.5 per cent, although some dealers have taken molybdenite concentrates carrying any amount of copper, since their process of roasting and extracting the molybdenum renders the copper insoluble in the residue.

GRAVITY CONCENTRATION

In treating wulfenite ores it has been found by some workers that the vanner proved an excellent machine for removing the associated oxide copper minerals from the wulfenite. Although it was known that wulfenite is somewhat friable it was found that the very fine wulfenite minerals of an unclassified feed would, when submitted to a vanner, readily attach themselves to the moving surface and be retained. This is because the mineral is readily wetted; while the gangue particles and copper minerals, being of lower specific gravity, and not so easily wetted, would be carried off by the stream of water, even though larger in size.

However, in the concentration of molybdenite by the oil flotation process sulphide minerals of copper, usually in the form of chalcopyrite, are likewise carried over with the molybdenite froth and are then found in a more concentrated state than originally present in the ore. Differential flotation, however, bids fair to eliminate this trouble, and very many successful experiments to this end have been made at the Golden Station of the United States Bureau of Mines. Horton,[1] in describing the deportment of chalcopyrite in the concentration of molybdenite, states that by both electrostatic and flotation methods they are concentrated together. The removal of pyrite and chalcopyrite from molybdenite is accomplished to a great extent by giving the ore or concentrates a careful roast. In this way the larger part of the pyrite and chalcopyrite are rendered magnetic and may be removed by means of a magnetic separator, or, through the formation of a coating of oxide on the surface of each particle, the pyrite and chalcopyrite in the ore are readily wetted and sink if the material is subjected to flotation. It is cheaper and more effective as regards ultimate recovery of molybdenite to remove the other sulphides after concentration rather than before. The danger in roasting molybdenite ores is that if the surface of the molybdenite becomes oxidized, its complete recovery by ordinary oil flotation processes will be doubtful.

Thornhill (U. S. Pat. 1,338,264) effects separation of molybdenite from other mineral sulphides by treating pulp with oil, whereby molybdenite appears to "coagulate" in preference to other minerals and can be separated by fine screening.

FLOTATION BY SURFACE TENSION

Another method suggested is that of oxidizing the surfaces of chalcopyrite at ordinary temperatures and later submitting the material to the Wood's surface-tension machine, whereby the chalcopyrite sinks while the molybenite flakes are floated on the surface and are recovered. It is known that the ordinary type of wet concentrating table will to a certain degree effect a separation, due to the flakiness of the molybdenite and to the fact that it is not readily wetted, which usually makes it the tailing product.

In case the ratio of copper to molybdenum is relatively large it is doubted whether any of the processes suggested above will reduce the copper content much below 1 per cent. The application of differential flotation may in the future be able effectively to separate molybdenite from chalcopyrite within the limits that are allowed, and very likely at the same time produce two marketable products—a copper and a molybdenum concentrate. This would then eliminate the costly roasting processes or hydrometallurgical processes now being attempted to solve this problem.

REACTIONS BETWEEN MOLYBDENUM AND IODINE

The accurate determination of copper in copper-molybdenum ores that have come to this station for testing by flotation processes and for the analysis of the products made therefrom is of importance to the metallurgist. After several trials had been made to determine copper by the ordinary methods in such products it was soon found that the presence of molybdenum was a serious hindrance. The standard iodide method of determining copper cannot be used without previously separating the molybdenum from the copper or *vice*

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[1] Horton, F. W., "Molybdenum: Its Ores and Their Concentration," U. S. Bureau of Mines Bull. 111, 1916, pp. 108-3.

versa, since under the conditions of titrating the liberated iodine by thiosulphate in the ordinary way molybdenum likewise liberates iodine and interferes. Free iodine is liberated when a solution containing molybdic acid (MoO_3) is boiled in the presence of potassium iodide and hydrochloric acid, as follows:

$2MoO_3 + 4KI + 4HCl = 2MoO_2I + I_2 + 4KCl + 2H_2O$,

or $2MoO_3 + 2HI = Mo_2O_5 + I_2 + H_2O$.

This reaction forms a basis for determining molybdenum. See Scott[2] and Treadwell and Hall.[3]

Incomplete Precipitation on Aluminum

In the ordinary standard copper-iodide method the bulk of the copper is previously precipitated by aluminum or zinc, which is followed by H_2S water to precipitate the small amount of copper which usually is difficult to precipitate by the previous treatment. It has been found that in the presence of molybdenum, zinc or aluminum in any form—sheet, granulated or powdered—will not completely precipitate the copper. H_2S water as used in the ordinary method for copper cannot be used for carrying down the remaining copper in solution, since this will likewise precipitate MoS_3 along with the copper sulphide. After making several attempts to precipitate the copper completely by zinc and aluminum in various forms without the use of H_2S and under different working conditions it was finally given up as being practically impossible, since it always led to the same erratic results. The chief difficulty with using aluminum strips or sheets is that the precipitated copper adheres so firmly to the metal when molybdenum is present in solution that the deposition of copper stops. Granulated zinc, however, gave the best results, but requires the complete solution of several grams of zinc, which leaves the copper in a very finely divided condition, and which is very difficult to filter off and wash without losing some of the precipitate in the filtrate, due either to its colloidal nature or to oxidation. No H_2S wash water could be used on account of the danger of precipitating MoS_3.

The use of sodium hydroxide for precipitating out the copper along with the iron-group metals was next tried out and proved satisfactory. By boiling, the copper hydroxide will be rendered insoluble, while the molybdenum passes into the filtrate. The precipitate must then be redissolved and reprecipitated to get rid of the trace of molybdenum remaining in the precipitate. The precipitate is next dissolved in dilute H_2SO_4 and the copper thrown out of solution by the ordinary procedure, using aluminum strips, copper filtered off, dissolved and titrated in the usual manner with standard thiosulphate. Although the use of this method is fairly satisfactory for determining copper, the time required for carrying out a determination by performing so many precipitations and filtrations would limit its use in a commercial laboratory where many determinations must be carried out in a single day. Besides these objections, the solution after each addition of the caustic must be boiled vigorously or heated for half an hour to render the copper completely insoluble.

Electrolytic Methods

A search through the technical journals revealed the fact that all the methods that had been devised for determining copper in the presence of molybdenum were modifications of the ordinary electrolytic method.[4]

Very likely for a particular class of material an electrolytic method could be used to advantage, but in commercial work it is probable that by the time all the conditions have been properly made, with all the interfering elements removed, it would have been quicker to carry out a determination by other means. The electrolytic method was therefore not tried out.[5]

After trying out several of the standard wet methods as outlined in various textbooks for determining copper it was found that the thiocyanate method, with a few modifications, gave a complete quantitative separation of copper from molybdenum, while the procedure could be easily and accurately controlled.

Modified Thiocyanate Analysis

Weigh out 0.5 to 5.0 g. of the finely pulverized material, depending upon the grade of sample, copper content not to exceed 0.20 g., into a 250-c.c. beaker or Erlenmeyer flask. Add 10 to 15 c.c. of HNO_3 and heat until the brown fumes are gone. This is the most effective manner of decomposing the sulphides present in an ore. Carefully add 5 to 10 c.c. of HCl and heat about twenty minutes, or until the ore is carried down to near dryness. On straight sulphide material the use of HCl can be dispensed with. Cool, dilute and add 10 to 15 c.c. of dilute sulphuric acid (1:1) and then if necessary just enough additional water to dissolve all the soluble salts in the residue or precipitate formed. If this is not done some nitrates are liable to cake on the bottom of the beaker or flask, or be trapped in the insoluble matter and may not be fully decomposed by the sulphuric acid. The presence of nitrates hinders the precipitation of copper. Evaporate the mixed acid solution down to copious fumes of H_2SO_4, cool, dilute with a little water, heat to dissolve soluble salts and if much residue is present, filter off, catching the filtrate in a 600-c.c. beaker, and wash residue at least five times with hot water. The final volume will be approximately 250 c.c. This filtrate (or diluted solution from an acid treatment which requires no filtering) is now ready for precipitating out the copper by means of a solution of ammonium thiocyanate, while the molybdenum remains in solution. To the above acid solution add NH_4OH until the solution becomes slightly alkaline, indicated by an iron precipitate, then add dilute H_2SO_4 (1:1) until the solution is made acid and contains about 2 c.c. of free acid in excess.

Next add 2 to 3 g. of anhydrous Na_2SO_3 to reduce the copper. At the same time the sulphite may reduce some of the molybdenum, giving a blue solution, depending upon the concentration of acid. If too much Na_2SO_3

[2]Scott, W. W., "Standard Methods of Chemical Analysis," 2nd ed., 1917, pp. 275-282.

[3]Treadwell and Hall, "Analytical Chemistry," vol. 2, 3d ed., 1912, p. 666.

[4]Hoepfner, W., and Bender, O., "Determination of Molybdenum in the Presence of Copper," *Chem. Zeit. Jahrg.*, vol. 42, 1918, p. 315, pp. 301-2; also *Chem. Abs.*, vol. 12, 1918, p. 2293. Treadwell, W. D., "Electro-Analytical Separation of Copper From Tungsten and Molybdenum," *Z. Elektrochem.*, vol. 19, pp. 219-21; see *Chem. Abs.*, vol. 7, 1913, p. 2170. McCay, L. W., and Furman, N. H., "Use of Hydrofluoric Acid in the Separation of Some Heavy Metals From Tin, Antimony, Tungsten and Molybdenum by Means of the Electric Current," *J. Am. Chem. Soc.*, vol. 38, 1916, pp. 640-52.

[5]In describing the electrolytic copper assay in the presence of molybdenum, Hawley states: "In the electrolytic method for assaying copper, molybdenum acts like arsenic and antimony, part precipitating and part remaining in solution. When too much is not present, the addition of a small amount of any chloride will prevent its precipitation. One mg. of sodium chloride will prevent about 6 mg. of molybdenum from precipitating. This small amount of chloride is insufficient to injure the copper deposit. When molybdenum precipitates, the color varies with the amount present. With very little, the color is a chocolate brown that rarely extends to the edge of the cathode. With still more, an iridescent steel-blue color is evident that approaches black as the quantity is increased." (*Eng. & Min. Jour.*, vol. 110, July 24, 1920, p. 162.)

should be added, indicated by a precipitate, add a little more of the dilute acid solution. Heat nearly to boiling and add 10 to 25 c.c. of a solution of NH_4CNS or KCNS containing 2 g. per 10 c.c. An excess of this reagent does no harm. The copper will be precipitated as cuprous sulphocyanate, CuCNS. Heat for a few minutes longer, or until the precipitate has coagulated and settled. Filter through a good grade of qualitative paper and wash with hot water until the blue color on the filter paper, due to reduced molybdenum, has been leached out. Usually five to eight washings will be sufficient. Redissolve the precipitate back into the original beaker by puncturing the filter paper and washing the content into the beaker with a small stream of hot water. Then pour onto the filter 10 c.c. of warm 1:1 nitric acid, which will dissolve the adhering bit of precipitate on the paper and the washed down precipitate held in the beaker. If the precipitate is small it can be easily and readily dissolved with a little hot 1:1 nitric acid poured directly upon the filter. Brown oxides of nitrogen are given off by the reaction.

The solution is then placed on the hot-plate and evaporated down practically to dryness. This requires but a very short time and more than balances the time spent in the straight iodide method, where the nitric acid solution of copper containing some bromine water must be boiled to drive off excess bromine, neutralized with ammonia, again boiled until excess ammonia is driven off, neutralized with acetic acid, cooled to room temperature and titrated with standard thiosulphate. The principal advantage in taking the nitric acid solution of the cuprous thiocyanide nearly to dryness at the start is to expel the cyanide formed and the excess nitric acid, thus eliminating practically all the trouble that usually is experienced in titrating low-grade copper solution with thiosulphate in the presence of ammonium salts. For it has been found that if much ammonium salts is present the precipitate of cuprous iodide forms with difficulty and the end point is then very uncertain and unreliable, it being rather doubtful when the blue color will not again reappear through the formation of a little more iodine caused by the slowness of the reaction, due to excessive amounts of ammonium salts present. If accurately performed the blue color should not reappear upon standing from three to five minutes.

After the copper solution has been evaporated as described it is cooled. In case it was carried to complete dryness add two or three drops of concentrated nitric acid, next add 50 c.c. warm water, then a few drops of concentrated ammonia until the solution becomes clear, giving the characteristic deep blue color; avoid using an excess. Usually five to ten drops will neutralize all the nitric acid present at this stage, and at the same time be sufficient to dissolve the first precipitate of copper hydroxide. Next add 5 to 10 c.c. acetic acid, cool to room temperature, add sufficient amount of potassium iodide solution and titrate the brown solution of liberated iodine containing cuprous iodide with standard sodium thiosulphate until the blue color of a starch indicator disappears. It is best to titrate without starch in solution until the brown tinge has become faint and then add sufficient starch solution to produce a marked blue color. Titrate cautiously until the blue color is entirely removed by a single drop. The c.c. of thiosulphate multiplied by the copper value of the reagent gives the weight of copper in the sample from which the percentage is calculated.[6]

Reactions

Reactions involved are:

$$2CuSO_4 + 2NH_4CNS + SO_2 + 2H_2O = 2CuCNS + 2H_2SO_4 + (NH_4)_2SO_4$$

$$CuCNS + 3HNO_3 = Cu(NO_3)_2 + HCNS + H_2O + NO_2$$

$$2(Cu.2C_2H_3O_2) + 4KI = Cu_2I_2 + 4(K.C_2H_3O_2) + 2I$$

$$2(Na_2S_2O_3) + 2I = 2NaI + Na_2S_4O_6.$$

According to the above equation 2Cu = 4KI, or 0.2 g. of copper requires about 1.05 g. KI, and 100 per cent excess over this theoretical quantity is always added before titration. Prepare a solution containing 50 g. KI in 100 c.c. Five to 6 c.c. of this solution will take care of any high-grade samples encountered. For low-grade samples 2 c.c. will be sufficient.

Interferences

Nitrogen oxides, ferric ions, trivalent arsenic and trivalent antimony must be absent, as they will either absorb or liberate iodine. Pentavalent arsenic and antimony do no harm; hence, if these are suspected in the ore, 5 c.c. of bromine water should be used along with the nitric acid, after dissolving the cuprous thiocyanate, care being taken that the excess is boiled off by evaporating nearly to dryness as recommended for the presence of excess nitric acid. The presence of 3 g. of tartaric acid is recommended by Lord and Demorest[7] to keep arsenic, antimony and bismuth in solution when the copper is precipitated with thiocyanate. The writers have never resorted to the use of tartaric acid, but prefer the use of bromine in ores suspected of carrying much arsenic or antimony.

Many tests were made to prove the accuracy of the method with synthetic solutions, but only a few representative ones will be given:

No.	Mo Present	Cu Taken	Cu Found
1	0.0500	0.0238	0.0239
2	0.1000	0.0513	0.0513
3	0.1500	0.0563	0.0564
4	0.2000	0.0109	0.0107
5	0.4000	0.0051	0.0049
6	.....	0.2681	0.2676
7	0.4000	0.0023	0.0025
8	0.5000	0.5638	0.5640

The results shown in Table I were obtained on molybdenum-copper ores and products, made from flotation experiments, which were analyzed by three methods: The thiocyanate method, as described above; by granulated zinc, and by the regular aluminum precipitation method. Results on the latter method show the radical results to be expected by the use of aluminum.

TABLE I. PERCENTAGE OF COPPER FOUND BY THE THREE METHODS

No.	Per Cent Mo	Per Cent Cu by Thiocyanate Method	Per Cent Cu by Excess Granulated Zinc	Per Cent Cu by Aluminum Strips
1	5.03	1.40–1.42	1.39–1.43	1.01–1.29
2	4.98	15.82–15.78	15.87–15.70	15.60–15.70
3	0.07	0.24–0.24	0.28–0.25	0.29–0.25
4	45.78	0.42–0.43	0.48–0.41	0.46–0.39
5	15.10	5.61–5.70	5.58–5.70	5.27–5.60

[6] The standard solution of sodium thiosulphate is made by dissolving 19.55 g. of pure crystals in 1 liter of distilled water. Lord and Demorest recommend adding 1 g. of NaOH to preserve the solution. The solution is next standardized by weighing out 0.2 g. of pure copper wire or foil, dissolve in 10 c.c. of 1:1 HNO_3, carried to near dryness and treated as outlined in the method above. One c.c. of the thiosulphate will correspond to about 0.005 g. of copper.

[7] Lord and Demorest, "Metallurgical Analysis," 1916, p. 206.

Messrs. Anderson and Prest of the Seattle Station, Bureau of Mines, have been able to use the following alternate method with good results on many ores.

Permanganate Method for Copper

The cupro sulpho-cyanate precipitate is dissolved in hot 10 per cent NaOH, copper hydroxide filtered off, and the NaCNS in the filtrate titrated with KM_nO_4, using ferric chloride on a spot plate as indicator of consumption of NaCNS. The solution is then made acid with H_2SO_4 and the liberated HCNS titrated until the usual permanganate end color is reached.

Some uncertainty exists as to the factor which will convert the iron value of the permanganate to the copper value. To fix this point, 0.20 g. of copper is dissolved in HNO_3 and carried through exactly as a regular determination.

Scott recommends that the precipitated sulpho-cyanate be weighed in a Gooch crucible after drying at 100 deg. C. The compound multiplied by 0.5226 gives the equivalent metallic copper. Or the dried precipitate may be burned with sulphur to Cu_2S. The factor is then 0.7986. In Scott's view, copper is separated as sulpho-cyanate from a great many elements without interference, except from silver, tellurium and selenium.

Synopsis of Recent Chemical & Metallurgical Literature

Superficial Burning of Low-Carbon Steel—In a paper read before the West of Scotland Iron and Steel Institute, James Mitchell refers to a type of defect which frequently arises in practice, which for want of a better term may be described as superficial burning. In such cases the metal is destroyed on the surface, presumably through the oxidizing effect of the flame employed in heating. It seems probable that this oxidation arises from the action of the surface scale formed on the piece. Microscopically it becomes apparent through decarburization of the superficial layers. After such treatment the failure of the metal is common, the reason being that the surface fissures caused through over-oxidation serve as starting points for the propagation of cracks throughout the steel. It may be argued that when fluxes are used on the metal such conditions do not readily arise. Mr. Mitchell's experience, however, has been that under such conditions fluxes afford a very poor protection, as the surface cinder formed is itself of a very oxidizing nature.

Wheel-Burnt Rails.—A derailment on the Baltimore & Ohio R.R. at Glenwood, W. Va., supposed to be due to a "wheel-burnt" rail—that is, a rail which had been intensely heated momentarily and locally by slipping wheels—led to a study and report of this type of damage by J. E. Howard, engineer-physicist of the Interstate Commerce Commission. Fragments of the broken rail (Fig. 1), the appearance of the rail head both before and after pickling in hot acid (Figs. 2 and 3), and microscopic examination (Fig. 4) show that the rail—which was a 75-lb. A. S. C. E. section in service for nine years—contained many fractures having origin at the hardened upper surface of the rail.

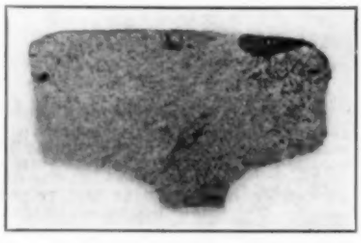


FIG. 1. TYPICAL END VIEW OF BROKEN FRAGMENTS

In his investigations Mr. Howard studied the internal strains and structure in a number of other wheel-burnt rails. He distinguishes between the hardening due to the cold-work attending a rolling load and the thermal hardening due to wheel-slippage. Rail steel embrittled by mechanical hardening commonly displays some residual ductility under wheel stresses, although it is incapable of further flow under tensile stresses. When a longitudinal element of the tread is cut from such a hardened rail it will increase slightly in length, thus showing it to have been under compressive forces. Thermal hardening due to wheel slippage, on the other hand, retains no residual ductility, is incapable of flow under wheel pressures, and the hardened portion is often of insufficient depth to support and distribute the impinging pressures of the wheels. Surface cracks were thus formed in the rail which caused the accident, some of which, under the alternate directions of the tractive forces of engine drivers and the resistance of the train wheels penetrated the head and culminated in rupture.

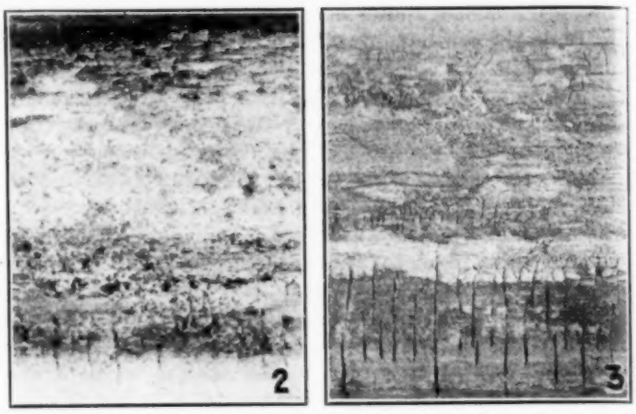


FIG. 2. APPEARANCE OF RUNNING SURFACE BEFORE PICKLING
FIG. 3. APPEARANCE OF RUNNING SURFACE AFTER PICKLING

In order to gain an idea of the stresses which may be set up locally by thermal hardening a number of rails were gaged and the changes in lengths noted after various amounts of metal had been cut away, and after various heat-treatments. The mean expansion in 10 in. after channeling the head of the rail and quenching the bar from 1,400 deg F. was 0.0235 in. (gaged length 10 in.). Progressive contraction occurs with increasing temperatures when annealing hardened steel—either hardened by cold-work or by quenching. Thus a hardened spot in a rigid rail head would

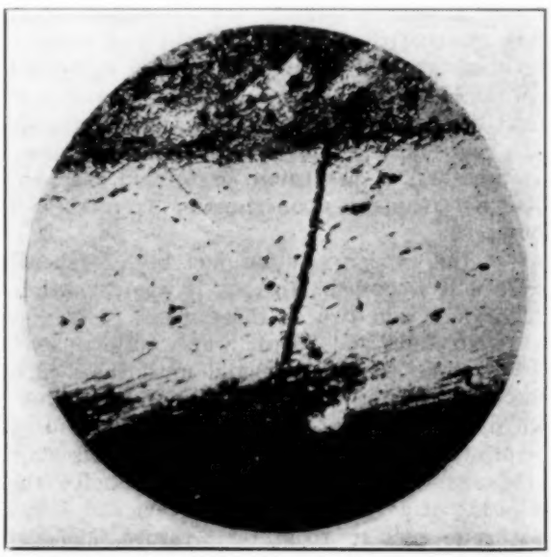


FIG. 4. CRACK THROUGH HARDENED METAL AT SURFACE OF RAIL-HEAD. LONGITUDINAL SECTION. × 100

be under a compressive stress of 70,500 lb. per sq.in., due to this volume change, while the rest of the rail would have tension induced in it, especially near the top; consequently the effect of local thermal hardening is opposite in direction to that of mechanical hardening. Intense internal strains, induced in rails in this manner, may reasonably be held to have exerted a great influence on the surface cracks exhibited in Fig. 2. However, the approach to rupture in steel in service is not signalized by visible manifestations.

Melting Scrap in Heroult Furnace.—W. E. Cahill describes in *Mining and Scientific Press*, April 16, 1921, p. 535, a 2-ton electric furnace operating at Treadwell, Alaska. With coke at $50 per ton, and pig iron correspondingly high, it has even become cheaper to make iron castings from this furnace, using hydro-electric power, than from a cupola. Operating "kinks" follow.

"Insulation" is common when starting the furnace on heavy scrap-iron. It often happens that the three electrodes will rest on top of the charge, and no current passes through. A good remedy is to add a few shovelfuls of clean turnings. In extreme cases one can always shovel in some coke, bringing the current over the top of the charge until a steady arc results.

"Iron castings are made about three or four times per week, the usual practice being to pour in the morning. Every afternoon we take off a heat of steel—high-carbon, low-carbon or alloy, depending upon the requirements. The melting of cold steel scrap in a cold furnace gave us considerable trouble at first. The melting starts at the top of the pile directly under the electrodes. The electrodes gradually work their way toward the bottom. As the steel melts it drops down and strikes the cold magnesite hearth and freezes. The electrodes continue their downward path until a pool of molten steel is formed and the melting of the scrap raises the level of the bath. The course is then upward until all the scrap is added. The layer of solid steel on the bottom cannot be melted by keeping the heat on the bath and without overheating or injuring the furnace. The trouble seems to be due to lack of circulation, the hot metal being on the top. This circulation can be insured by the addition of iron ore, which causes the metal to boil and so washes out the layer of frozen metal. Hematite has proved most satisfactory for this purpose, as its action is quick and the effect on the slag is slight. Frequent testing of the bottom with a steel bar is necessary; for, after the steel is free, continued boiling will wash out magnesite, causing slag troubles. This condition is common when using heavy scrap. When proper scrap is available the density of the charge may be so arranged that the electrodes will penetrate near to and will heat the bottom. Great care must be used when the scrap is light, especially if the electrodes are penciled, for the pool of steel formed might not be of sufficient depth to prevent the electrodes from boring into the bottom. It is advisable to know the length of the electrode (that is, the distance from the holder to the furnace bottom), so that if the position becomes dangerous the current may be reduced until it starts to rise.

"Several months ago we had a 'heat' of steel nearly ready to pour, but the power went off and the charge froze in the furnace. A break in the line kept the current off until the next day. By chipping away the slag from under the electrodes we were able to start the circuit. After having the current on the solid chunk for two and a half hours the maximum depth of the pool of molten steel was about 3 in. The furnace was getting very hot, so we started feeding ore. When the carbon content became low pig-iron was added. By alternate addition of ore and pig the steel was finished, and the furnace was poured clean within five hours from the start.

"The charging of the furnace influences the melting. Gates and risers make a good charge for the bottom, giving the proper density; and, being at the bottom, the coating of sand does not interfere with the electric conductivity when starting operations. Light scrap is placed on the top and may be piled a foot or more above the doors. A small piece of coke is placed on top of the scrap directly under each electrode. The coke makes a better contact, acts as a cushion, and prevents violent surges of current when starting. The former practice of using hand-control for starting has been discontinued, and automatic control is now used. Peak loads seldom exceed 850 kw., whereas the working load is between 500 and 600 kw. After a steady arc is formed, usually about five minutes after starting, lime is shoveled around the electrodes to form the basic slag. Later, as the charge melts, more lime is added. If the scrap melts so as to expose part of the roof to the glare and reflected heat of the arc it is well to work over some of the light top scrap with a bar, so as to shade the arc and prevent unequal heating of the roof."

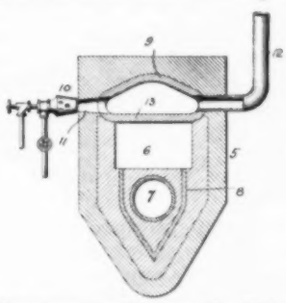
Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

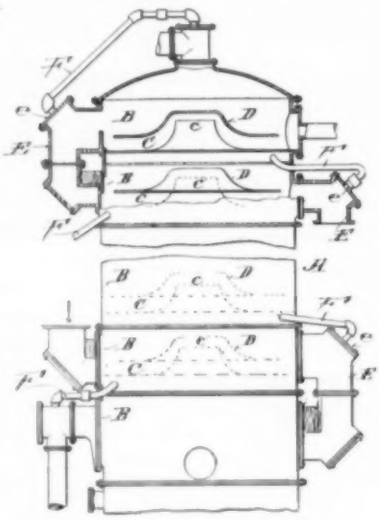
Tribenzyl Phosphate in Celluloid Manufacture.—As a colloiding agent for cellulose esters, FRITS E. STOCKELBACH, of New York, recommends tribenzyl phosphate in preference to triphenyl phosphate or tricresyl phosphate. As an example, celluloid may be manufactured by mixing 75 parts of nitrocellulose with 25 parts of tribenzyl phosphate or with 10 parts of tribenzyl phosphate and 15 parts of camphor. Celluloid made in this way does not discolor when exposed to light and is much less flammable than the corresponding product made with camphor alone. (1,370,853; assigned to Commonwealth Chemical Corp.; March 8, 1921.)

Modified Induction Furnace for Melting Scrap.—A furnace body 5 has an interior chamber 6 below which is an opening 7 for the primary core and primary coil. Molten metal within the channel 8 forms the secondary, the arrangement being such that the metal in the furnace is kept in circulation by motor effect in channel 8. The circulation promoted in this manner in the lower part of the bath is quite efficient but, owing to the oil and dirt on the scrap metal and the air in the interstices between the fragments, the upper part of the charge may become insulated and separated from the lower part, forming a bridge or arch over the latter in the nature of a crust which is not heated sufficiently to melt, as above pointed out. In order to overcome this drawback and the consequent loss of efficiency, auxiliary heating means are provided above the upper surface of the charge constituted by a retort 9 of refractory material or the like formed in or adjacent to the roof portion of the furnace. This retort 9 serves as a combustion chamber and is heated interiorly by an oil burner 10 or the like, which in this instance is arranged exteriorly of the furnace and is adapted to project a jet of flame into the retort through an opening 11. (1,370,632; WALTER R. CLARK, of Bridgeport, Conn., assignor to Bridgeport Brass Co.; March 8, 1921.)



Distilling Column for Ammonia.—In the operation of apparatus in which a volatile content of a liquid, as ammonia, is distilled off by passing steam through the liquid, it sometimes happens that the liquor admitted at the top of the column does not flow freely through it, but accumulates to an abnormal depth in the pans composing it, thus checking up the upward flow of steam and to a greater or less extent blocking the operation. This difficulty is due to the fact that the steam rising from the

boiling liquid in the overflow passages opposes the flow of liquid from the pans to the passages to such an extent that the flow of liquid is checked, thus increasing the depth of liquid in the pans. This increase in the depth of the liquid seal in the pans tends to prevent the steam passing up through the column from following its normal path and to cause it to break through into the overflow passages, thus increasing the original difficulty. An improved apparatus has been designed by GEORGE W. CRUPE of Buffalo, N. Y. Referring to the drawing, *A* indicates a distillation column, composed of a series of superimposed rings *B*, *B*. In each ring is a pan, or faux fond, *C*, having a central opening *c*, over which is a hood, or passette, *D*, whereby steam passing up through the column and through the openings *c* is forced to pass through the liquor in the pans. Leading from each pan to the pan below is an overflow pipe or passage *E*, whereby the liquor, overflowing from the several pans, passes downward from pan to pan, through the column. Connected with upper part of each of the overflow pipes *E*, and preferably with the cover plate *e* of the overflow pipe, is a vent pipe, *F*, the upper, or discharge, end of which is above the inlet opening of the overflow pipe and preferably directly under the pan or faux fond of the next succeeding ring above.



In the operation of the device the steam rising from the highly heated liquor in the overflow passage *E* is free to discharge through the vent pipe *F*, instead of passing through the inlet opening of the overflow pipe *E*, and thus is prevented from obstructing the flow of liquor into the overflow pipe.

By this means a more rapid feed of liquor to the column is made possible, and with a uniform feed of liquor a substantially constant depth of liquor is maintained in each pan, thus insuring uniformity and cleanness of operation. (1,372,649; assigned to Semet-Solvay Co.; March 22, 1921.)

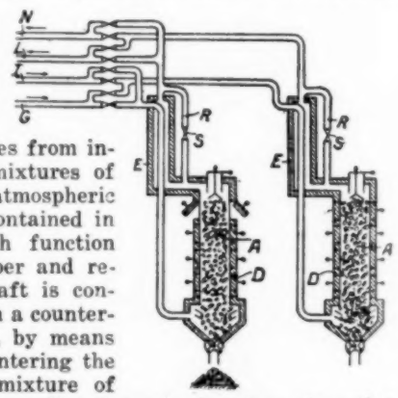
British Patents

Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Dispersoids.—Dispersoids or colloidal suspensions of ores, dyes, paints, graphite, sulphur, cellulose or other materials are obtained by pounding or rubbing the ground substance in a dispersion medium which is a non-conductor or a bad conductor of electricity, the moving surfaces having a velocity of not less than 2,000 m. per minute, and preferably of 1,000 m. per second. Dispersion may be assisted by adding solvent chemical agents, or those which form labile compounds with the dispersion medium without much ionization, or those which assist the formation of compounds between the material to be dispersed and the dispersion medium. A colloidal suspension of sulphur may be made by dispersing flowers of sulphur with water or other medium, with or without the addition of protective colloids such as benzol or carbon bisulphide. Molten sulphur may also be converted into the dispersoid condition, the temperature being gradually lowered during the operation. Sulphur may be refined by treating the dispersoid with acid, washing, and dispersing again in pure water. The colloidal solutions may be used for disinfection, or for treating plants. Colloidal graphite is made by dispersing crude graphite with hot water, then cooling while under treatment, allowing to stand, decanting from the sediment, and drying. Potash olein soap, barium, phenol-sulphonic acids such as naphtho-disulphonic acids may be added to accelerate the process of dispersion. Colloidal ultramarine is made by dispersing a mixture of coarse grained ultramarine and olein soap with water or an organic dispersion medium such as benzol, or alcohol with or without the addition of oil or turpentine: the product is dried. Other colors—e.g., iron, cobalt, zinc, lead, nickel or chrome colors—or lithopone or dyes may be similarly treated. Alkali, oils, or phenol-sulphonic acids may be used, instead of soap, as accelerators. An "enamel substance," such as artificial or natural resin, size, cellulose ester, copal, etc., may be dispersed in organic solvents for the production of enamels "in which the lakes are not dissolved but dispersed." Cellulose—for instance, wood pulp—is dispersed in water with or without the addition of gelatin, protein or soap and alkali, the cellulose is rendered flocculent by addition of acid, separated and dried under vacuum. The mass is homogeneous and may be pressed in molds. Organosols of cellular materials such as cellulose may be obtained by means of benzol, acetone, etc.; small quantities of cellulose ester soluble in acetone can be used as accelerators of dispersion. (Br. Pat. 155,836; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. See also Pat. 156,142. March 2, 1921.)

Arsenobenzene Derivatives.—Stable solutions are obtained by mixing solutions of 3:3¹-diamino-4:4¹-dioxyarsenobenzene sulphoxylate and the sodium salt of 3:3¹-diamino-4:4¹-dioxyarsenobenzene or the complex silver compound thereof, or by mixing the two ingredients in powder form and dissolving the mixture. The resulting solution contains the two ingredients in chemical combination, that made from the sodium salt not being precipitated by carbon dioxide, and that made from the silver compound not being precipitated by salt or carbon dioxide. (Br. Pat. 155,577, not yet accepted; G. SPEYER HAUS, assignor to Farbwerke vorm. Meister Lucius & Bruning, Hoechst-on-Main, Germany; Feb. 23, 1921.)

Separation of Atmospheric Nitrogen.—Relates to the production of nitrogen by absorption of oxygen from a mixture of nitrogen and oxygen by means of metals such as iron, followed by the regeneration of the oxide produced; and consists in utilizing the heat generated by the absorption reaction to provide the heat required for the regeneration process. Since too large an excess of heat is developed by the use of atmospheric air in the absorption reaction, gases containing only about 10 per cent of oxygen are employed—e.g., flue gases from industrial plants, or mixtures of these gases with atmospheric air. The metal is contained in two shafts *A*, which function alternately as absorber and regenerator. Each shaft is connected at the top with a countercurrent preheater *E*, by means of which the gases entering the shaft—namely, the mixture of nitrogen and oxygen supplied through pipe *G* or the reducing gas supplied through pipe I—are heated at the expense of the gases leaving the shaft; viz., pure nitrogen by the pipe *L* or exhauster reducing gas by the pipe *N*. The preheater can be short-circuited to any required extent by the valved pipe *R*. The shafts *A* are covered with adjustable heat-insulating plates *D*, in order to control the radiation of heat therefrom. The active mass of metal may also be varied. The danger arising from the formation of soot is avoided by introducing carbon dioxide into the water gas before it enters the regeneration apparatus. The carbon dioxide may be that contained in water gas which has already been through the apparatus. (Br. Pats. 155,814 and 155,815; not yet accepted; C. T. THORSELL and H. L. R. LUNDEN, Gothenburg, Sweden. March 2, 1921.)



Current Events
in the Chemical and Metallurgical Industries

Nitrogen Reasearch to Continue

The U. S. Fixed Nitrogen Research Laboratory at American University, Washington, D. C., will be continued under War Department auspices for the present for the purpose of completing and rounding out experiments now under way and so that a comprehensive report of research activities on nitrogen fixation and utilization may be prepared. There is also a desire to continue this laboratory until the War Department is assured that it can obtain sufficient nitrogen from domestic sources to meet its needs. After that the laboratory is to be turned over to the Department of Agriculture, which is expected to continue the experimentation as to nitrogen fixation and utilization. No forecast can be given at this time as to when the transfer will be made.

This is a part of the ruling of the Secretary of War in the matter of the department's nitrate policy. He also decided that the Nitrate Division of the Bureau of Ordnance should remain as an entity. In addition he reached the conclusion that pending the development of the fixation of atmospheric nitrogen by private industry, to the point where an adequate supply of nitrogen to meet the government's requirements is assured, the government plants at Sheffield, Ala., and at Muscle Shoals, known as Plants No. 1 and No. 2, will be retained in the most economical stand-by condition.

The research work being done at the Fixed Nitrogen Laboratory is on a large scale. Expenditures in connection with that activity now are being made at the rate of $250,000 a year. More than 100 chemists are employed. Work now will be concentrated on completing the present studies and designs of synthetic ammonia process and on the completion of a comprehensive report on nitrogen fixation and utilization.

Dye Control Amendment Goes to Senate

The emergency tariff bill was reported to the Senate April 30 containing Title V, which is to be known as the "dye and chemical control act, 1921." It was found that sufficient funds are now available to continue the work of dye and chemical control for another six months. This resulted in the elimination of the appropriation carried in the Knox amendment as originally drafted. Several other minor changes were made. As reported to the Senate the dye and chemical title reads:

> Sec. 501. (*a*) That on and after the day following the enactment of this act, for the period of six months, no sodium nitrite, no dyes or dyestuffs, including crudes and intermediates, no product or products derived directly or indirectly from coal tar (including crudes, intermediates, finished or partly finished products, and mixtures and compounds of such coal-tar products), and no synthetic organic drugs or synthetic organic chemicals, shall be admitted to entry or delivered from customs custody in the United States or in any of its possessions unless the Secretary determines that such article or a satisfactory substitute therefor is not obtainable in the United States or in any of its possessions in sufficient quantities and on reasonable terms as to quality, price and delivery, and that such article in the quantity to be admitted is required for consumption by an actual consumer in the United States or in any of its possessions within six months after receipt of the merchandise.
>
> (*b*) Upon the day following the enactment of this act the War Trade Board Section of the Department of State shall cease to exist; all clerks and employees of such War Trade Board Section shall be transferred to and become clerks and employees of the Treasury Department and all books, documents, and other records relating to such dye and chemical import control of such War Trade Board Section, shall become books, documents and records of the Treasury Department. All individual licenses issued by such War Trade Board Section prior to the enactment of this act shall remain in effect during the period of their validity, and the importations under such licenses shall be permitted. All unexpended funds and appropriations for the use and maintenance of such War Trade Board Section shall become funds and appropriations available to be expended by the Secretary in the exercise of the power and authority conferred upon him by this section.
>
> Sec. 502. That this title may be cited as the "Dye and Chemical Control Act, 1921."

In its report urging the adoption of the title the Committee on Finance said:

> At the present time the importation of coal-tar dyes and certain chemicals is regulated by means of licenses issued by the War Trade Board Section of the State Department, under the provisions of the trading with the enemy act approved Oct. 6, 1917, and the proclamation of the President of Feb. 14, 1918. It is deemed advisable to continue the present licensing system for a period of six months after the enactment of the proposed amendment in order that the Congress may have ample time to enact into law permanent tariff legislation covering importations of dyes and chemicals. The proposed amendment is deemed to be necessary because the powers of the War Trade Board Section of the State Department to grant licenses for the importation of dyes and chemicals are limited to the duration of the present war. The proposed amendment is limited to the dyes and chemicals the importation of which is now limited by licensing, and provides for the granting of licenses upon substantially the same terms as under the requirements for the importation of dyes and chemicals from enemy countries.
>
> The proposed amendment provides for the transfer of the functions of the War Trade Board Section, including its clerks and employees, books, documents, and records, to the Treasury Department. The proposed amendment also provides that any unexpended funds and appropriations made for the use and maintenance of the War Trade Board Section shall be available to be expended by the Secretary of the Treasury in the exercise of the power and authority conferred upon him by the proposed amendment.

Annual Tables of Constants and Numerical Data

The publication of the Annual Tables of Constants and Numerical Data, Chemical, Physical and Technological, which was interrupted during the war, has now been resumed by an international commission acting under the authority of the International Union of Pure and Applied Chemistry.

Subscriptions to Volume IV, containing all numerical data published during the years 1913 to 1916 inclusive, will be received up to May 31 at the following rates: Part I only, $12.50 bound, $11 unbound; Parts I and II, $25 bound, $22 unbound. Part I, containing the constants from "Compressibility" to "Electricity," will be delivered probably early in July; Part II, with the remaining constants, some months later. Subscription blanks can be obtained from the American Commissioner, Prof. E. W. Washburn, University of Illinois, Urbana, Ill. Remittances should be made to the Chicago University Press, Chicago, Ill.

Orders for Volumes I, II and III will be received at $7.20 each. Vol. I is, however, not sold separately, owing to limited supply. Volume V, covering the years 1917 to 1920 inclusive, is in preparation and will be ready for distribution late in 1922.

Preliminary Program, American Leather Chemists Association

At the meeting of the American Leather Chemists Association to be held at Atlantic City June 9 to 11 topics will be discussed which will be of interest to the practical men of the industry as well as the chemists.

The committee in charges announces the following preliminary program:

Colloids, Prof. Holmes (University of Cincinnati); Chestnut Wood Tannin, R. W. Griffith; Notes on the Extraction of Leather, Bureau of Chemistry; Post-Mortem Tests on Hide, G. D. McLaughlin; Moisture in Leather and Tannin Materials, T. D. Jarrell; Relation of South America to the Leather Industry, G. A. Kerr; Conditions in the Leather Industry, L. J. Robertson; Tanning Materials in the Far East, Dr. L. Balderston; Demonstration of the Explosiveness of Tannery and Leather Dusts, Bureau of Chemistry; Some Further Comments on the Wilson-Kern Method of Analysis, G. W. Schultz.

A symposium is to be held on the general subject of Synthetic Tannins. Various committee reports for the years 1920-1921 will be presented by the chairmen. The final program will be given out later.

Aims and Organization of the Materials Handling Division, A.S.M.E.

The new Materials Handling Division of the American Society of Mechanical Engineers is planning sessions for the discussion of "Design and Construction of Machinery for Road Building" at the Society's spring meeting to be held at the Congress Hotel, Chicago, May 23 to 26. Four papers will treat this problem from the viewpoint of the contractor, the road builder, and possible future development of mechanical equipment in road building.

The work of this Division, whose membership is rapidly approaching one thousand, is now well under way. The executive committee of the Division has adopted the report of the aims and organization committee, which mapped out a comprehensive working scheme. The executive committee is composed of R. M. Gates, chairman, Philadelphia; H. V. Coes, vice-chairman, New York; N. C. Johnson, New York; F. A. Wardenberg, Wilmington, Del.; and Kern Dodge, Philadelphia. The aims and organization committee is headed by F. M. Feiker of New York. Describing the aims of the Division, this report says:

"Materials handling is largely a mechanical engineering problem. It divides itself into two parts: (1) The consideration of the detailed design and operation of mechanical equipment for handling material, and (2) the economical and efficient application of this equipment in the arts and industries. The purpose of this Division is to organize, direct and promote these two foregoing objects. The formation of a Division will stimulate engineering thought and provide a method of expression which will make possible the more efficient methods and means of handling the commodities in our daily life. The Division shall have the following specific objects:

"To co-ordinate and correlate existing data and information, to find the gaps in the knowledge so as to bridge them, and to render the sum total available to the greatest possible number.

"To work toward standardization of methods and designs wherever feasible and possible with the belief that such standardization will reduce costs of handling materials.

"To promote actively the discussion of materials handling in all its economic and engineering phases to the end that it may take its rightful place in future engineering thought and opinion.

"To point out the economic wastes of duplication of effort, of manual labor and of undirected and unplanned material handling in all its phases.

"To aim to correlate the work of all engineers in materials handling.

"To co-operate with other divisions or other associations and organizations.

"To initiate and aid research.

"To assist in solving national, state and community handling problems.

"To establish an information division which would be prepared to furnish such information as a compendium of all devices now on the market, a list of references classified under materials handling."

The activities of the Division are outlined as follows:

"Materials handling in this division is concerned only with what may be called the problems of secondary transportation of materials and commodities. It does not concern itself with the broad transportation problems of the common carriers, or the tributaries to common carriers.

"Materials handling has to do with the multitudinous operations of 'picking up and putting down' materials in process of production, and the handling problems of the linkages between common carriers and delivery to the user."

Discussing the method of approach to the problem of materials handling, the report says:

"The objective in any materials handling problem is the reduction of costs. The professional division therefore will approach the problem in general as follows:

"Make a survey of the existing industry to ascertain the present state of the art.

"Make studies for the improvement of machinery and equipment for the handling of materials.

"Ascertain ways and means of reducing costs."

Prime consideration will be given to two sets of problems in the field of the Materials Handling Division: (1) The technical problems of the industries, and (2) the commercial fields of materials-handling machinery.

The report sums up the spirit of the new Division with this striking statement:

"The subject of materials handling should be taken out of a rule-of-thumb basis and put on an engineering basis in all its phases. To this end the Professional Materials Handling Division of the A.S.M.E. should devote itself."

Research Fellowships in the College of Mines, University of Washington

The College of Mines of the University of Washington offers four fellowships in mining, ceramic and metallurgical research in co-operative work with the Bureau of Mines. The fellowships are open to graduates of universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is $900 per year of twelve months, beginning July 1. Fellowship holders are required to register as graduate students and to become candidates for the degree of Master of Science in mining engineering or metallurgy, or ceramics, unless an equivalent degree has previously been earned.

The purpose of these fellowships is to undertake the solution of various problems being studied by the United States Bureau of Mines that are of especial importance to the State of Washington, the Pacific Northwest and Alaska. The investigations consist principally of laboratory work directed largely by the bureau's technologists. For the year 1921-22 the following subjects have been selected for investigation:

(1) Beneficiation of coal, especially coal washing.

(2) Electrometallurgy. Electrothermic and electrolytic treatment of various mineral resources.

(3) Ceramics. Survey and testing of the clay resources of the Northwest to determine their economic utilization.

Applicants should send a copy of their collegiate records from the registrar's office of the college where they have been, or will be, graduated. They should also state their professional experience and give the names and addresses of at least three persons who are familiar with the character, training and ability of the applicant. Applications are due not later than June 1, and should be addressed to the Dean, College of Mines, Seattle, Wash.

Sugar Mills in the Hawaiian Islands Listed

Information concerning the sugar mills of the Hawaiian Islands, including the names of the companies, agents, location of factories, date of erection, and capacities, is contained in a list compiled by the Far Eastern Division, Bureau of Foreign and Domestic Commerce, Washington, for which request file No. FE-26004.

An Association of Employees' Clubs

On May 25 a conference will be held in New York City to effect organization of an association of the employees' clubs of America. Active membership will consist of clubs, associations or societies of employees of industrial, financial, mercantile or other organizations having for their main purposes social, athletic, educational, thrift and savings, health, safety or other similar mutual benefit activities; companies having "clubs" holding active membership will be associate members.

The direct purpose is exchange of such service, information and experiences between member clubs as will aid in increasing their usefulness and the enthusiasm of their membership. The more general purposes will be to promote better understanding and more cordial relations among employees and between employees and employers generally.

Plans for the organization have been under way for several months by a temporary committee with headquarters on the 22d floor, Times Building, New York City. All concerns or persons interested in such activities are urged to get in touch immediately with the chairman or other members of the executive committee: C. Lester Horn, chairman, 22d Floor, Times Building; Roger Steffan, educational director, National City Bank, New York City; L. W. DeMotte, director of personnel, American Express Co., 65 Broadway, New York City; D. A. Henderson, personnel manager, Knox Hat Co., 601 Grand Ave., Brooklyn, New York; J. Marshall, staff secretary, Alexander Hamilton Institute, 13 Astor Pl., New York City; George E. Morgan, welfare supervisor, Otis Elevator Co., 260 Eleventh Ave., New York City; Dr. C. E. Ford, General Chemical Co., 25 Broad St., New York City; MacLean Libbey, secretary, Stanley Insulating Co., 200 Fifth Ave., New York City.

Rochester Meeting, Division of Chemistry and Chemical Technology, Research Council

A meeting of the Division of Chemistry and Chemical Technology, National Research Council, was held at the Hotel Powers, Rochester, on the afternoon of April 27. Chairman Cottrell announced that the International Research Council would meet at Brussels on June 27 and that the United States is to be represented by six members. Prof. H. N. Holmes of Oberlin College presented a report reflecting favorably upon the activities of his colloid chemistry committee: Over 100 lectures had been delivered by members of the committee during the course of last year on various phases of colloid chemistry; the interest in colloid chemistry was increasing remarkably fast; Bancroft issued a long list of colloid chemistry problems, many of which have been taken up by the laboratories; Holmes issued a reference list of books and periodical literature compiled for those who cared to study the subject of colloids more fully; Bancroft and Holmes each published a book on colloid chemistry. An equally favorable and highly encouraging report was presented by Dr. E. W. Washburn on ceramic research during 1920. Among other things, a fellowship in ceramics has been established. In the discussion of the report it was suggested to include electrical porcelain in the program for this year. Dr. Bancroft reported on the activities of the contact catalysis committee, referring in particular to the very successful symposium recently held on the subject.

Charles E. Munroe, chairman of the committee on explosives investigations, outlined the work that his committee had performed during the past year: The list of literature references on explosives has been brought up to date, starting with the earliest publications; a detailed record of accidents has been kept, together with accounts of causes and suggestions for future prevention of such accidents. Dr. Munroe further suggested that the numerous investigations on explosives carried out during the war be written up, collected and published. Steps in this direction had already been taken by the British Government and a number of volumes already published.[1] The Council decided to take up Dr. Munroe's suggestion. Dr. J. M. Francis presented a brief report on pharmaceutical research; Dr. Stieglitz discussed the situation of research in synthetic drugs. Since the armistice the interest in research in these drugs has waned.

Dr. H. T. Clarke brought up the question of preparing lists of research chemicals. The difficulties encountered by investigators at present was to locate certain chemicals essential to their experiments. The idea was to prepare lists of both organic and inorganic chemicals with brief references as to where each could be obtained. The chair appointed a committee to undertake the work. A lengthy discussion followed on the publication of Tables of Critical Constants; Dr. H. K. Moore, chairman of the committee, reported that $100,000 had been received in subscriptions. Dr. Johnson of Yale advised that Dr. C. J. West, formerly with A. D. Little, Inc., had been appointed editor of the tables.

At the conclusion of the meeting the following officers of the Division were elected for the ensuing year: Chairman, F. G. Cottrell; vice-chairman, Julius Stieglitz; executive committee, F. G. Cottrell, Julius Stieglitz, W. D. Bancroft, Colin G. Fink, W. F. Hillebrand, R. B. Moore; members at large, Treat B. Johnson, R. B. Moore.

[1]Publishers, His Majesty's Stationery Office, London.

Opposes Duty on Iron Pyrites

That a duty on pyrites will not protect the domestic product from sulphur competition was one of the arguments used by C. H. MacDowell, president of the National Fertilizer Association, who was granted a special hearing by the subcommittee on chemicals of the Ways and Means Committee of the House of Representatives. Mr. MacDowell stated that the production of pyrites from domestic sources is very expensive, in addition to being unsatisfactory in some ways for consumption by the interests which are large users of Spanish pyrites. A duty on pyrites, he declared, would have the effect of applying protection to sulphur, a product which exists domestically in such large quantities as to enable the United States to dominate the world's market and consequently is in no need of protection.

The chances seem favorable for some duty on potash. It is regarded as practically certain, however, that the committee will not approve as much as 50c. a unit, which was the amount asked by the domestic producers.

Every precaution is being taken by the members of the Committee on Ways and Means to prevent the dissemination of any information as to the schedules on which the subcommittees are agreeing. Due to the fact that these schedules are likely to be changed by the full committee it is believed that unnecessary agitation would be created by allowing the day-to-day conclusions to be announced. It is pointed out that ample time will remain after the permanent tariff bill is reported for those concerned to "shoot" at any of its schedules. The prohabilities are that the bill will not be reported until near the end of May.

National Fertilizer Association to Meet at White Sulphur Springs

The twenty-eighth annual convention of the National Fertilizer Association, which will be held at White Sulphur Springs, W. Va., the week beginning June 20, 1921, will have a program of reconstruction and co-operation.

The program will include addresses and discussions on subjects that are of vital interest to the fertilizer manufacturer in view of present business conditions. These subjects will include costs and cost-accounting systems, chemical and manufacturing problems, sales methods, labor and transportation problems, etc. The officers of the association are now arranging the details and promise a meeting which will be of unusual interest and lasting benefit to everyone identified with the fertilizer industry. On account of the importance of the program a large attendance is expected.

During the same week the Southern Fertilizer Association will hold its summer meeting; the soil improvement committee of the National Fertilizer Association will hold a subscribers' and committee meeting; the soil improvement committee of the Southern Fertilizer Association will hold a committee meeting.

Oilfield Developments in Northern Canada

The Canadian Department of Mines has changed its plans with regard to the method of transporting the geologists assigned to the Fort Norman and Windy Point districts. Arrangements had been made with the Canadian Air Force for the aërial transportation of both men and supplies, but this has been found to be too costly, and the slower, but possibly surer, method of transportation by barges is to be used. Barges are being constructed for the purpose, and will travel by way of the Peace, Slave, and Mackenzie rivers. The Imperial Oil Co. will adhere to its original plan of transporting men and supplies by air, the two all-metal airplanes already having made one trip to Windy Point, Great Slave Lake, carrying 1,000 lb. gasoline each. They returned without mishap, and, it is expected, will leave for Fort Norman within a few days.

A good deal of opposition is being brought against the bill in the legislature at Edmonton, Alta., to grant a pipe-line right-of-way to the Imperial Oil Co. The route is not specified and very wide powers are asked. The company consequently has withdrawn the bill. The legislature will take up pipe-line legislation next session.

The Imperial Oil Co. will erect a small refinery near Fort Norman during the coming summer to provide gasoline for the company's airplanes and power boats. It is expected that a sufficient quantity will be made to supply other concerns in the district.

The British Columbia Department of Mines has let a contract to Lynch Bros. of Seattle to sink a 2,000-ft. bore-hole near the south fork of the Red River, about 20 miles northwest of Hudson Hope. Prof. John A. Dresser was employed to make a reconnaissance survey of the oil possibilities of this section of the Peace River region, and it is on his recommendation that the hole is being sunk.

Joint Brands and Trade Marks Used in Foreign Markets by U. S. Export Associations

A new feature in the development of foreign trade, reported by the Federal Trade Commission, is the adoption of joint, uniform brands and trade marks by associations organized under the Webb-Pomerene law for the purpose of export trade. Heretofore, in most cases, individual members of an association have retained their own marks on exports; but under the new plan an association brand or trade mark may be adopted to cover all goods shipped by the combine.

In advertising American goods abroad concentration on one or a few brands or marks which convey a guarantee of quality has proved to be much better business than the use by one association of a bewildering number of individual marks which may compete with one another and confuse the foreign buyer. Aside from advertising value, this feature represents an important step toward co-operation in export trade.

The U. S. Alkali Export Association of New York has abandoned the use of individual marks, and reports the adoption of a new association trade mark which will be advertised through agencies in South America, Cuba and Mexico.

The trade mark "Apex" is found on about 200 varieties of paper and board shipped by the American Paper Exports, Inc., of New York to Europe, Asia, Africa and South America.

The Consolidated Steel Corporation of New York advertises under the mark "Consteco."

Trade marks and stenciled designs are used by the Cement Export Co., Inc., of New York; the American Tanning Materials Co. of New York; and other associations operating in export trade under the Webb-Pomerene law.

Employment in Chemical Industries Decreases

A decrease of 2.3 per cent in employment in the chemical industries took place during April, according to an announcement by the Department of Labor. There was a decrease of 3.2 per cent in employment in the stone, clay and glass industries.

Administration Favors Fact Finding

Some opposition is being voiced in the non-metallic mineral industries to certain of the fact-finding activities of the Federal government. In that connection it may be mentioned that there is overwhelming opinion in Congress in favor of compulsory returns from industry of certain fundamental facts. It is the policy of the administration to favor legislation of this type, rather than that which contemplates regulatory supervision. For the immediate present it is expected that compulsory fact finding will be required only as to coal and three or four other basic industries. Once the legislative precedent is established, however, an extension of the policy could be put through promptly if it could be shown that the public interest would be served. One of the best ways to insure the enactment of such legislation is for producers to refuse to supply fundamental data voluntarily.

Aluminum Sulphate Used at Water-Purification Plants in Illinois, 1920

Data collected relative to use of aluminum sulphate at twenty-two of the water-purification plants in Illinois during 1920 show that 2,300 tons of alum was used, ranging from 5 tons at some of the smaller plants to about 780 tons at the largest plant. The cost ranged from $24 to $160 a ton. Analyses made at some of the plants show Al_2O_3, 17 to 17.25 per cent; insoluble matter, 0.1 to 0.2 per cent; Fe, 0.5 to 0.75 per cent. In some instances the alum is purchased without specifications, and in others the specifications vary considerably. The alum has been purchased from four different companies.

Two Cent Duty on Sugar Asked

A duty of 2c. on imports of sugar is being urged by domestic cane producers for the permanent tariff bill. The emergency tariff measure carries a duty of 1.16c. per lb. It is understood that the subcommittee has decided on 1.6c. per lb. for the permanent tariff bill.

A duty of 100 per cent ad valorem is being urged for adonite, arabinose, dulcite, galactose, inosite, inulin, levulose, mannite, d-talose, d-tagatose, ribose, melibose, dextrose testing above 99.7 per cent, mannose, melitzitose, raffinose, rhamnose, salicin, sorbite, xylose and others of the higher saccharides required for scientific purposes.

Weights and Measures Conference

The fourteenth annual meeting of the National Conference on Weights and Measures will be held at the Bureau of Standards in Washington, D. C., May 23 to 26. The announcement by Representative Vestal that he sees no reason for delaying further the discussion before his Committee on Weights and Measures of the respective merits of the existing system of weights and measures and those of the metric system insures the discussion of that topic at the forthcoming meeting.

Congress May Ban Deceptive Containers

Legislation prohibiting the use of containers shaped so as to deceive or mislead the purchaser as to the "quantity, quality, size, kind or origin" of the contents may be expected at this session of Congress. It will be in the form of an amendment to the food and drugs act which has been introduced by Representative Haugen, chairman of the Committee on Agriculture.

To Investigate Muscle Shoals Projects

The American Farm Bureau Federation has appointed a committee to investigate thoroughly the questions involved in the Muscle Shoals controversy. The committee is authorized to engage engineers and to incur necessary expense of a thorough probe, with the idea of developing whether or not the government development on the Tennessee River would be beneficial to the agricultural industry. The committee consists of John Brown, Indiana; W. G. Jamison, Colorado, and Chester H. Gray, Missouri.

Personal

Dr. RAYMOND F. BACON addressed the Delaware Section of the American Chemical Society on Monday evening, May 2. His subject was "Some Problems in the American Sulphur Industry."

ERNEST J. P. BENN, member of Benn Bros., Ltd., publishers of the *Chemical Age*, London, England, and other technical magazines, who is making a visit to the United States, was entertained at luncheon at the Engineers' Club on May 5 by the Associated Business Papers, Inc.

EDMUND W. CRAFT of the Thermoid Rubber Co., Trenton, N. J., gave an interesting address on the subject of crude rubber before the members of the local Engineers' Club at a recent meeting. A. H. Greywacz, of the same company, followed Mr. Craft with a comprehensive talk on some of the technical features of rubber processes.

Dr. MAX MUELLER, president of the Rhodia Chemical Co., New York, is on a pleasure trip to the Pacific Coast, accompanied by Mrs. Mueller.

HOWARD M. RAYMOND has been appointed acting president of the Armour Institute of Technology to fill temporarily the vacancy caused by the death of Dr. F. W. Gunsaulus. Acting President Raymond is a graduate of the University of Michigan, and is well known professionally throughout the Middle West. He has been connected with the Institute for the past twenty-six years, and has served as dean of engineering since 1903.

Dr. JOHN E. TEEPLE has been elected president of the Chemists' Club.

JOHN THOMAS, the chief chemist of Scotch Dyes, Ltd., and J. E. Breckinridge, a director of the same company, both of Carlisle, Scotland, are in the United States on a business visit.

Obituary

ARTHUR R. WILLIS, chemical expert for the Tariff Commission, lost his life in an accident on the Potomac River Sunday, April 24. He was twenty-nine years of age and had been with the Tariff Commission nearly three years, having had charge of the compilation of the Census of Dyes and Coal-Tar Chemicals.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, May 9, 1921.

There was some improvement shown in chemical inquiries during the past week and reports of better business are becoming more frequent. Throughout the trade the month of April seems to have shown a decided change over previous months. The inertia of the market has necessarily made the change gradual, nevertheless activity is moderately increasing. While at the present rate it will still require a number of months to reach anything like normal conditions, the progress is encouraging. The labor and freight problems are still the most unfavorable factors confronting the producers of chemicals.

FOREIGN COMPETITION

Foreign competition is being strongly reflected in the chemical market. Imported materials are still figuring very largely in the situation and in the majority of cases domestic manufacturers realize the futility of trying to meet the importers' prices. There are a few cases, however, where competition is keen between domestic and foreign goods for interior points, with the advantage resting with the manufacturer on account of freight charges. Imported *prussiate of soda*, *citric* and *tartaric acids*, *chlorates*, *bleach* and *caustic potash* are being offered below producers' prices here. *Soda ash* is another item that is attracting some attention. This chemical has been sold for shipment in practically every case. It is understood that sellers of this material are not eager to bring ash in unless sold ahead. Prompt shipments of ash were offered by importers at $1.90 per 100 lb. ex-dock New York. Producers have not announced any further change in either ash or caustic soda prices and it is understood that a fair business is being placed for home consumption in both items. Standard brands of caustic soda and soda ash have remained steady on spot and the market looked firmer at the close than it did at the opening. The call for small lots of bichromate of soda was sufficient to hold the market around 7¾c. per lb. Imported prussiate of soda was slightly firmer during the week under tighter offerings and a better inquiry. Oxalic acid has maintained a firm tone on both foreign and domestic material and demand has kept prices at 17c. per lb. and above all week.

OUTLOOK MORE FAVORABLE

The outlook in general may be considered more favorable. A settlement of the German reparations question will bring about a far-reaching change in affairs. The position of the Allies would be materially strengthened financially and otherwise. It will mean an early revival of trade with Europe. International credits and exchanges would soon be stabilized. With the return of the second greatest trading nation a new revival in world commerce would be seen everywhere. Additional markets for American goods, therefore, would be opened.

GENERAL CHEMICALS

Hydrochloric acid prices are fairly steady in the absence of any pronounced activity. Commercial acid in carboys is quoted at prices based on $1.65 per 100 lb. for the 20 deg. grade. Larger quantities could be obtained down to $1.50. Following continued shading in various directions, makers are now quoting lower prices on 66 deg. sulphuric acid. Prices based on tank carlots f.o.b. works are quoted at $18@$20 per ton. Business has been rather slow. Prices on *oleum* and 60 deg. acid have remained practically unchanged. Lack of demand for *ammonium sulphate* prevents possible firmness and prices, while quoted on the former basis, are subject to shading in all directions. Quotations of $2.75 per 100 lb. for export in double bags can undoubtedly be shaded to a decided extent and the bulk price at works, which has been quoted at $2.75, can now be had as low as $2.50 per 100 lb. White *arsenic* can be had as low as 7½c. per lb., although there are a few holders in the market at 8c. per lb. Little interest has been noted in the *bleach* market during the week and prices have been easy in most directions. The resale market is around $2.50 per 100 lb., with works delivery from second hands down to $2.25. Manufacturers are holding their quoted prices around $2.75 per 100 lb. f.o.b. works. Resale *bichromate of potash* is not in heavy supply at present and most dealers quote 11¾@12c. per lb. for limited quantities. In some quarters sales of odd lots have been made down to 11½c. per lb.

Makers of *caustic potash* are quoting lower prices based on 12c. per lb. for the 88-92 per cent material and are unable to attract buyers in view of the state of the market. Resellers of American reshipped material are offering at 4½c. per lb., but the condition of these goods is very doubtful. Importers are quoting German potash at 5½@6c. per lb. An advance in shipment prices from abroad in *prussiate of soda* had a strengthening influence on spot quotations. At the close the market was quoted firm at 11¾@12½c. per lb. The market on *carbonate of potash* continues inactive and prices are rather soft. Offerings of 96-98 per cent

carbonate are heard at 9c. per lb. Holders of this and lower grades are eager to accept any reasonable offer on their material. Makers of *salt cake* are in a position to offer their goods below recent figures. Prices are now named at $30@$35 per ton for the bulk. Resellers and importers of *acetate of soda* are competing at prices around 4½c. per lb. Makers are holding off and their prices are around 6½c. per lb. Spot offerings of *nitrite of soda* are not to be found below 5¾c. per lb. Stocks in resale hands are still heavy, although the market generally shows signs of strength. Improvement in demand for *copper sulphate* has taken place during the week and considerable business has been placed for agricultural requirements. Export inquiries have also increased and it looks as though France, Italy and South America are going to be fair buyers. In the case of European countries their production is restricted on account of the scarcity of raw material and they are looking to America for supplies. The domestic copper market has remained quite firm for the past few weeks and this condition seems to have convinced consumers of the sulphate that the market has really reached bottom. Leading producers quote carlots at 5½c. per lb. for the standard 99 per cent large crystals. The outlook for business in this chemical is considered better than for some time past. Moderate quantities of standard brand *caustic soda* were on the market around $3.65@$3.70 per 100 lb. ex-store N. Y. and $3.75 f.a.s. steamer. Carlot trading has remained rather quiet in the open market, although it is understood that producers have been able to place a fair business at the works. Contracts are quoted at 3¾@3½c. per lb., basis 60 per cent f.o.b. works. Resale lots of light *soda ash* in single bags were distinctly firm in the final trading and dealers stated that it is doubtful if spot material could be purchased under $2.05 per 100 lb. Barrels sold higher at $2.30 per 100 lb. The feeling on spot goods was very steady even though a considerable amount of imported goods was noted to arrive. At the works producers quoted $1.62½@$1.72½ per 100 lb., basis 48 per cent, for single bags.

Coal-Tar Products

A revival of interest in some directions has been noted in the coal-tar products market. Some very sizable orders have been placed in the resale market during the week, but as a rule sellers have been forced to sacrifice on prices. After the long period of inactivity, however, any movement is a welcome sign to holders. Those with any accumulated stocks are so tired that they are willing to make any concessions that will start some active trading. It is only recently that consumers have been willing to exhibit any interest in taking on stocks. Few price changes have been noticed which can be taken as indicating anything radical. The crude market remained steady during the week with a fair trading in *benzene* and *naphthalene*. Intermediates in general are in better demand with no special changes.

There were rumors of new strength in *benzene* without any confirmation. Competition among refiners has been quite keen for any business that has been around and offers have been made at prices below quotations where there was a possibility of developing actual business. Quotations on pure benzene are based on 27c. per gal. in tank cars and range up to 32c. in drums. *Aniline oil* ranges from 21@26c. per lb. *Beta naphthol* sales in some large volume have been reported in the resale market during the week. The prices quoted have undergone no noticeable change as the transactions were more or less of a private nature. Offerings were generally around 33c. per lb. with sales recorded down to 32c. Makers are finding no business at their quoted prices of 40@45c. per lb. Factors of *H acid* say that the past week has witnessed a little better movement and views of prices of first hands are steady at $1.40 per lb., while in resale quarters the market was easier and shading possible at $1.20@$1.25 per lb. There was little change noted in the market on *benzidine* and trading was moderate with supplies rather steady. The base material ranges from 90@95c. per lb. and the sulphate from 80@85c. Inquiries for *phenol* were more frequent and actual trading was reported in some quarters on a larger scale. Government supplies are still available at 12c. per lb., while in other quarters nothing much under 10c. was thought possible.

Waxes

Prices on *beeswax* were unsettled, due to freer offerings and rather moderate buying interest. Pure white wax was offered at 45@47c. per lb. with the undertone easier. Crude Brazilian was nominally held at 21@23c. per lb. For the African grade of crude the market closed around 15½@16½c. per lb. Recent heavy importations of *carnauba wax* resulted in easing the spot situation and at the close offerings of the higher grades were noted at 60@62c. per lb. No. 2 North Country was available at 28@30c. per lb., while these figures could have been shaded on actual business. Spot offerings of *Japan wax* were reported at 18@18½c. per lb., indicating that prices were a shade easier. Demand for spot material was quiet and with futures unsettled interest in forward business was also lacking. Despite the uplift in crude petroleum the market for *paraffine wax* was easier throughout the week. Refiners appeared more anxious for business and offerings for scale wax were noted here at prices ranging from 2½@2¾c. for carlots, immediate shipment. Refined paraffine also came out in large volume and at the close there were sellers of 125-127 deg. melting point at 4½c. per lb., with the 130-132 deg. m.p. at 5@5½c. The presence of some distressed material had a depressing influence on the market.

The Chicago Market

CHICAGO, May 6, 1921.

An improvement in the general tone of the industrial chemical market was evident during the past week. Naturally this was noticeable only in certain sections of the market, but the fact that there is any business at all is considered most encouraging. Price changes were few, and most factors seem to think that the majority of items have reached bottom. However, there are several items on the list that are far from the normal level and can be expected to go lower. One of the more important ones in this class is *potassium permanganate*, which has shown a steady decline during the past two months. This material is now offered at 38@40c. per lb. In contrast with the pre-war price of 8@10c., it is only reasonable to expect further reductions.

General Chemicals

Soda ash is quiet, the prevailing quotations being 2½@2¾c. per lb. in small quantities. Caustic soda, 76 per cent, is quite firm and is quoted at $4.10 per 100 lb. for the solid and $4.75 for the ground. Holders show no disposition to shade these figures and claim that they are doing a fair volume of business. White granular *ammonium chloride* is in better demand and 9c. per lb. for large casks was the best offer noted. Non-beverage *alcohol*, 190 proof, is quoted by distillers at $4.85 per gal. for single drums. The completely denatured is lower and No. 6 is available from first hands at 33c. per gal. in 5-drum lots. The mild winter left large quantities of this material on the market and it is available from the holders at almost any price.

Barium chloride is unchanged and is quoted at $75@$80 per ton. *Carbon tetrachloride* is very firm and it is doubtful if supplies could be had at a figure lower than 11½c. per lb. *Carbon bisulphide* has also shown a firm tendency and spot material is quoted at 8@8½c., according to quantity. *Formaldehyde* showed a further decline and first hands are asking 15½c. per lb. for barrels. The demand has dropped off somewhat and there seems to be little moving at the present. *Potassium carbonate*, 80-85 per cent, is quoted nominally at 11c., but with large business concessions could probably be secured. Second hands still have control of the *caustic potash* market and 88-92 per cent material is available at 8@8½c. per lb. *Bichromate of potash* is steady, the prevailing quotation being 14½c. per lb. for single casks. *Sodium bichromate* is very firm and holders are asking 9@10c. per lb. for material of standard brands. *Glycerine* c.p. is firmer and is moving in a small way at 17c. per lb. for large or small drums.

The list of acids is unchanged and manufacturers do not seem to contemplate price reductions, at least not in the near

future. There is a fair quantity of *acetic acid*, 28 per cent, moving to the photographic trade at 2¾@3c. per lb. in barrels. *Hydrochloric acid* is in limited request and is offered at 2@2½c. per lb. in carboys. There is a somewhat better demand for *sulphuric acid*, which is offered at $19@$20 per ton in tank cars or 2@2½c. per lb. for carboys.

Vegetable Oils

Quiet conditions still prevail in this branch of the trade and dealers express little hope for better conditions for several months. *Palm oil* is quoted at 8@10c. per lb., according to the holder. *Soya bean oil* is extremely quiet and is offered at 7½@8c. per lb. in small lots. *Linseed oil* is higher, dealers asking 65@67c. per gal. for the boiled with corresponding prices for the raw.

Naval Stores

The local market for naval stores has shown a considerable improvement during the past two weeks. *Turpentine* was advanced sharply, most factors asking 74c. per gal. for a good grade material. *Rosin* is still available at $8 per 280 lb. for the WG grade, but dealers say that higher prices can be expected.

Coal-Tar Products

There were no noteworthy features in the coal-tar market and business was of the same quiet nature that has been characteristic of this branch of the trade for several months. Prices were unchanged, *benzene* being offered at 28@31c. per gal. for the 90 per cent and 30@33c. for the pure. *Toluene* is available at 33c. for the refined grade. *Naphthalene flakes* are moving in a small way to the wholesale drug trade and are offered at 8½@10c. per lb.

The St. Louis Market

St. Louis, May 6, 1921.

Inaugurating our St. Louis letter, we wish to point out that the market comments will be confined chiefly to those articles which are produced and consumed in St. Louis or which move in volume through this distributing center.

Conditions during the past two weeks show some improvement and the general tone is optimistic.

Alkalis

The *caustic soda* market is very unsettled due to the large consumers buying only for their immediate needs on the spot market and not anticipating their requirements or entering contracts. Prices are $3.85@$4.50 per 100 lb. There is little activity in *soda ash*, with a few carload sales reported recently. Round lots are quoted at $2.95@$3 per 100 lb., basis 58 per cent. *Sal soda* is moving in the routine way at $1.95@$2.50 per 100 lb. *Bicarbonate of soda* is very inactive.

Industrial Chemicals

There has been no change in price of *aqua ammonia*, and a fair business is being done. The market for *carbon bisulphide* is very firm and buyers should have no hesitancy in ordering liberal quantities. *Copperas* is moving in a fair way and is quoted at 90c.@$1.00 per 100 lb. f.o.b. producer's works. There has been a decline recently in *sulphur* of ½c. per lb., but this has been counterbalanced by an equal advance in freight rates in the past two weeks. Therefore, sulphur continues to hold at 2c. per lb. for the commercial flour.

Drugs and Pharmaceuticals

Apparently the *acetone* market is firm at 12½@13c., with occasional second-hand lots being offered at a lower figure. There has been a marked improvement in *bismuth* preparations in the past two weeks, the increased demand being probably due to the favorable prices at which they are quoted. The demand for *bromides* is fair, but buyers are ordering only for their immediate needs, hence the market is weak. *Cream of tartar* is in greater demand than expected but *acid tartaric* is weak. *Glycerine* continues weak at 16½c., with no great demand. *Salicylates* are moving fairly well, and there should be no question about buying, as prices have probably reached their lowest. A fair volume of business in *sodium benzoate* is reported and should show a decided increase very shortly with the approach of the preserving season. Prices on *zinc oxides* remain the same, with an increasing demand for the lead-free, probably due to the revival of the rubber industry. A good volume of business in *zinc stearate* is being done and should continue in view of the summer demand.

Vegetable Oils

Linseed oil reacted the past week to a 66c. maximum and is today quoted at 64c. warehouse and in cooperage or 61c. carload for direct shipment from crushers. *Castor oil* is reacting from its low position and is now holding at 9½c.@10c. with a fair demand. *Turpentine* has slowly reacted and is now quoted at 63½c. The recent cold weather has had its effect on the crops to the extent that the yield will be decreased at least 75 per cent in this territory, and as a consequenc there is no activity in *insecticides* except for *paris green*, for which there is a good demand on a 30c. basis.

Paint Materials

The *barytes* market is very firm, with prime quality holding at $25.50@$26.50 f.o.b. mills. Apparently the unsettled condition in *lithopone* is disappearing due to the carload buyers again purchasing their usual quantities, and continued activity is expected. Prices are 7@7½c. carload.

Acids

The demand for *acids* has been very good and in view of the import price now being on a higher basis than the domestic manufacturers' prices there should be a material increase in sales. *Phosphoric acid sirupy*, with the approach of the soft-drink season, should show quite a bit of life and move in larger volume in the next few weeks. Sales of *gallic*, *pyrogallic* and *tannic acid* have shown a decided increase lately, with many large orders originating in England.

The Iron and Steel Market

Pittsburgh, May 6, 1921.

Conditions in the iron and steel trade this week are distinctly disappointing, not because they have grown worse, but because they do not record the improvement that was expected from the occurrences of three weeks ago. According to the expectations there should be more business on mill books and a larger operation, but there is not.

In the price equalization of three weeks ago, from a condition in which the independents had much lower prices than the Steel Corporation, the independents advanced their prices somewhat, while the Steel Corporation reduced its prices. As the independents were withdrawing their former prices, they allowed buyers to take advantage of the previous quotations on such tonnages as they were able to specify. By this operation it was thought the independents had rolled up a considerable tonnage of actual business, such as would give them a larger operation. By the Steel Corporation's reducing its prices and of course concurrently revising prices in contracts outstanding, it was the expectation that the corporation would receive specifications against its contracts at a much heavier rate.

The condition the past week, however, has been that the independents have been receiving very little new business and the Steel Corporation has been receiving specifications at what is, on the whole, a very low rate.

The average operating rate of the independents, developed from a symposium of estimates, appears to be only about 30 per cent of capacity, a rate no better than the poorest rate since Jan. 1 and probably somewhat under the maximum rate, which seems to have fallen about April 1. As to the Steel Corporation, its rate is generally believed to be several points below 40 per cent of capacity and at nearly if not quite the poorest rate of the year. In January the Steel Corporation operated at about 90 per cent and the independents at about 30 per cent.

Production of pig iron by the merchant furnaces is at a still lower rate, only between 15 and 20 per cent of capacity. That is to be explained chiefly by the fact that there are stocks of pig iron to be consumed. The great majority of

merchant furnaces are now out of blast, but roughly speaking before the furnaces went out they provided customers with all the pig iron they would take on contract, and also piled iron in their own yards. Doubtless the rate of consumption of merchant pig iron is low, but in all probability it is considerably greater than the present rate of production.

Steel Prices Holding

The new steel prices are holding, but the real test must come later. There is no incentive at present to cut prices, inquiry being so light. Quotations on leading products are: Billets, $37; slabs, $38; sheet bars and small billets, $39; rods, $48; bars, 2.10c.; shapes, 2.20c.; plates, 2.20c.; hoops and hot rolled strips, 2.75c.; plain wire, 3c.; wire nails, $3.25; steel pipe, 61½ per cent basing discount; blue annealed sheets, 3.10c.; black sheets, 4c.; galvanized sheets, 5c.; tin plate, $6.25.

Wages

The United States Steel Corporation has announced a general wage reduction, effective Monday, May 16. Common labor is reduced approximately 20 per cent, which presumably means from 46c. to 37c. as the hourly rate, with an adjustment of other wage rates and of salaries. The independents began reducing wages early in December, there being no regularity or uniformity. Some made one large reduction, others two or three smaller ones at intervals. The last important reductions by independents were at the middle of February, involving the leading independents in the Mahoning and Shenango valleys and the leading independent in the Pittsburgh district. While the independent rates have not been uniform, they average about the same as the rates to which the Steel Corporation is now going, from three to five months after the independents took their various actions.

The Steel Corporation makes no change in working conditions, but states that the 12-hour day will probably be eliminated within a year. The basic 8-hour day remains quite generally in force where it previously obtained, men being paid time and a half for hours in excess of eight.

One is given to understand that the Steel Corporation's wage reduction is in relation to the price reductions the corporation made three weeks ago, so that no further modification of the corporation's prices is to be expected at this time. However, the announcement does not seem to have any stimulating influence upon steel buyers, it being regarded rather as a disturbing factor at the moment.

Prospects

Obviously the consumption of steel is at a very low rate compared with the activity of the first nine months of last year, so that there is no prospect of steel being required from the mills at higher than the present rate as long as fundamental conditions remain as they are. The common view is that there will be no material change until next fall, and by reason of temperamental or other differences the time for a definite improvement is variously set from August to October.

Pig Iron

Basic iron remains quotable at $22.50 valley, with only a very occasional transaction. Foundry iron is quotable at $24, a 50c. decline, while bessemer remains nominally at $25. Price prospects are complicated by the fact that freight rate reductions are expected at some indefinite time in the future. Possibly the development of anything like a widespread demand would produce competitive bidding for orders.

Coke

Connellsville coke does not continue to decline as was expected in some quarters. The furnace at Portsmouth, Ohio, which over a month ago bought coke at $3.50 has renewed the contract for thirty or sixty days more, 500 tons a day, at the reported price of $3.40, but only the producer holding this contract seems willing to go below $3.50. Foundry coke remains quotable at $5 to $5.50. Prices are per net ton at ovens.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	–	$0.40 – $0.45
Acetone	lb.	$0.13 – $0.13½	.15½ – .14
Acid, acetic, 28 per cent	100 lbs.	2.50 – 2.75	3.00 – 3.25
Acetic, 56 per cent	100 lbs.	4.00 – 4.25	4.50 – 5.50
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		9.50 – 9.75	10.00 – 10.50
Boric, crystals	lb.	.13½ – .14	.14½ – .15
Boric, powder	lb.	.15 – .15½	.16 – .16½
Citric	lb.	–	.46 – .47
Hydrochloric	100 lb.	1.50 – 1.65	1.75 – 2.00
Hydrofluoric, 52 per cent	lb.	.13 – .13½	.14 – .14½
Lactic, 44 per cent tech	lb.	.10 – .11	.11½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .05½	.06 – .07
Molybdic, C. P.	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		–	–
Nitric, 40 deg.	lb.	.06½ – .06½	.07 – .07½
Nitric, 42 deg.	lb.	.07½ – .07½	.07½ – .08½
Oxalic, crystals	lb.	.17 – .18	.18½ – .20
Phosphoric, ortho, 50 per cent solution	lb.	.17 – .17½	.18 – .19
Picric	lb.	.30 – .32	.35 – .40
Pyrogallic, resublimed	lb.	–	1.90 – 2.15
Sulphuric, 60 deg., tank cars	ton	–	12.00 – 13.00
Sulphuric, 60 deg., drums	ton	–	14.00 – 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 – 20.00	–
Sulphuric, 66 deg., drums	ton	22.00 – 22.50	23.00 – 23.50
Sulphuric, 66 deg., carboys	ton	–	–
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	23.00 – 24.00	–
Sulphuric, fuming, 20 per cent (oleum) drums	ton	25.00 – 26.00	26.50 – 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00 – 35.00	40.00 –
Tannic, U. S. P.	lb.	–	.90 – 1.00
Tannic (tech.)	lb.	.50 – .52	.54 – .57
Tartaric, crystals	lb.	–	.35 – .39
Tungstic, per lb. of WO	lb.	–	1.30 – 1.40
Alcohol, Ethyl	gal.	–	4.75 – 5.25
Alcohol, Methyl (see methanol)		–	–
Alcohol, denatured, 188 proof	gal.	–	.34 – .38
Alcohol, denatured, 190 proof	gal.	–	.40 – .45
Alum, ammonia lump	lb.	.04 – .04½	.04½ – .04½
Alum, potash lump	lb.	.04½ – .04½	.04½ – .05
Alum, chrome lump	lb.	.13 – .13½	.14 – .14½
Aluminum sulphate, commercial	lb.	.02½ – .02½	.02½ – .03
Aluminum sulphate, iron free	lb.	.03 – .03½	.03½ – .04
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ – .07¾	.08 – .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .32	.33 – .35
Ammonium carbonate, powder	lb.	.07 – .07½	.08 – .09
Ammonium chloride, granular (white salammoniac) (nominal)	lb.	.06½ – .06¾	.07 – .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.08 – .08½	.09 – .10
Ammonium sulphate	100 lb.	2.50 – 2.75	2.80 – 2.90
Amylacetate	gal.	–	4.00 – 4.25
Amylacetate tech	gal.	–	3.00 – 3.25
Arsenic oxide, (white arsenic) powdered	lb.	.07½ – .08	.08½ – .08½
Arsenic, sulphide, powdered (red arsenic)	lb.	.12 – .12½	.13 – .14
Barium chloride	ton	60.00 – 65.00	70.00 – 75.00
Barium dioxide (peroxide)	lb.	.19 – .20	.21 – .22
Barium nitrate	lb.	.10 – .10½	.10½ – .11
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ – .05	.05½ – .06
Bleaching powder (see calc. hypochlorite)		–	–
Blue vitriol (see copper sulphate)		–	–
Borax (see sodium borate)		–	–
Brimstone (see sulphur, roll)		–	–
Bromine	lb.	.40 – .41	.42 – .45
Calcium acetate	100 lbs.	1.90 – 2.00	–
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	27.00 – 29.00	30.00 – 32.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium hypochlorite (bleach gpowder)	100 lb.	2.50 – 2.65	2.70 – 2.90
Calcium peroxide	lb.	–	1.25 – 1.50
Calcium phosphate, tribasic	lb.	–	.15 – .16
Camphor	lb.	–	.65 – .68
Carbon bisulphide	lb.	.07 – .07½	.07½ – .08
Carbon tetrachloride, drums	lb.	.10 – .10½	.11 – .12
Carbonyl chloride (phosgene)	lb.	–	.75 – 1.00
Caustic potash (see potassium hydroxide)		–	–
Caustic soda (see sodium hydroxide)		–	–
Chlorine, gas, liquid cylinders (100 lb.)	lb.	.08 – .09	.09½ – .10
Chloroform	lb.	–	.38 – .40
Cobalt oxide	lb.	–	3.00 – 3.10
Copperas (see iron sulphate)		–	–
Copper carbonate, green precipitate	lb.	.23 – .24	.25 – .27
Copper cyanide	lb.	–	.50 – .62
Copper sulphate, crystals	lb.	.05¼ – .05½	.05½ – .06
Cream of tartar (see potassium bitartrate)		–	–
Epsom salt (see magnesium sulphate)		–	–
Ethyl Acetate Com. 85%	gal.	–	.90 – 1.00
Ethyl Acetate pure (acetic ether 98% to 100%)		–	–
Formaldehyde, 40 per cent	lb.	.14 – .14½	.14½ – .15
Fusel oil, ref.	gal.	–	3.25 – 3.50
Fusel oil, crude	gal.	–	1.50 – 1.75
Glauber's salt (see sodium sulphate)		–	–
Glycerine, C. P. drums extra	lb.	–	.17 – .17½
Iodine, resublimed	lb.	–	3.75 – 3.85
Iron oxide, red	lb.	–	.10 – .20
Iron sulphate (copperas)	100 lb.	.75 – 1.00	1.10 – 1.25
Lead acetate	lb.	–	.11½ – .13½
Lead arsenate, paste	lb.	.08½ – .09	.09½ – .10
Lead nitrate	lb.	–	.15 – .20
Litharge	lb.	.08½ – .09	.09½ – .10
Lithium car bonate	lb.	–	1.25 –
Magnesium carbonate, technical	lb.	.10½ – .11	.11½ – .12
Magnesium sulphate, U. S. P.	100 lb.	2.75 – 3.00	–
Magnesium sulphate, technical	100 lb.	–	1.25 – 2.25
Methanol, 95%	gal.	–	.75 – .77
Methanol, 97%	gal.	–	.78 – .82
Nickel salt, double	lb.	–	.13 – .13½
Nickel salt, single	lb.	–	.14 – .14½
Phosgene (see carbonyl chloride)		–	–
Phosphorus, red	lb.	.45 – .46	.47 – .50
Phosphorus, yellow	lb.	–	.35 – .32
Potassium bichromate	lb.	.11½ – .12	.12½ – .12½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ ... – $	$0.30 –$0.35
Potassium bromide, granular	lb.	... –	.17 – .30
Potassium carbonate, U. S. P.	lb.	.35 – .40	.45 – .50
Potassium carbonate, crude	lb.	.06½– .07	.08 – .09
Potassium chlorate, crystals	lb.	.08 – .09	.10 – .14
Porassium cyanide	lb.	... – ...	.30 – .32
Potassium hydroxide (caustic potash)	lb.	.05 – .05½	.06 – .08
Potassium muriate	ton	50.00 – 50.50	... – ...
Potassium iodide	lb.	... – ...	2.75 – 3.00
Potassium nitrate	lb.	.09¼– .09½	.10 – .12½
Potassium permanganate	lb.	.32 – .33	.34 – .35
Potassium prussiate, red	lb.	.33 – .35	.36 – .38
Potassium prussiate, yellow	lb.	.27 – .27½	.28 – .29
Potassium sulphate (powdered)	per unit	... – ...	1.75 – 1.80
Rochelle salts (see sodium potas tartrate)		... – ...	... – ...
Salammoniac (see ammonium chloride)		... – ...	... – ...
Sal soda (see sodium carbonate)		... – ...	... – ...
Salt cake	ton	... – ...	30.00 –35.00
Silver cyanide	oz.	... – ...	1.30 – 1.35
Silver nitrate	oz.	... – ...	.41 – .42
Soda ash, light	100 lb.	2.05 – 2.10	2.15 – 2.40
Soda ash, dense	100 lb.	2.40 – 2.45	2.50 – 2.75
Sodium acetate	lb.	.04½ – .04¾	.05 – .05½
Sodium bicarbonate	100 lb.	2.50 – 2.60	2.70 – 3.00
Sodium bichromate	lb.	.07½– .08	.08¼– .08½
Sodium bisulphate (nitre cake)	ton	5.00 – 5.25	5.50 – 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.05¼– .05½	.05¾ – .06
Sodium borate (borax)	lb.	.06½– .06¾	.07 – .07¼
Sodium carbonate (sal soda)	100 lb.	2.00 – 2.10	2.15 – 2.50
Sodium chlorate	lb.	.07½– .07¾	.08 – .08½
Sodium cyanide	lb.	.20 – .22	.23 – .30
Sodium fluoride	lb.	.12 – .12½	.13 – .14
Sodium hydroxide (caustic soda)	100 lb.	3.65 – 3.75	3.80 – 4.00
Sodium hyposulphite	lb	... – ...	.03½ – .04
Sodium nitrate	100 lb.	2.75 – ...	2.85 – ...
Sodium nitrite	lb.	.05½– .06	.06¼ – .07
Sodium peroxide, powdered	lb.	.25 – .26	.27 – .30
Sodium phosphate, dibasic	lb.	.04½– .04¾	.05 – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	... – ...	.27 – .28
Sodium prussiate, yellow	lb.	.11½– .11¾	.12 – .12½
Sodium silicate, solution (40 deg.)	lb.	1.25 – 1.35	1.40 – 1.50
Sodium silicate, solution (60 deg.)	lb.	.02¾– .03	.03¼ – .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 – 1.75	2.00 – 2.25
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.05½– .05¾	.06 – .06½
Sodium sulphite, crystals	lb.	.03½– .04	.04¼ – .04½
Strontium nitrate, powdered	lb.	.15 – .15½	.16 – .17
Sulphur chloride, red	lb.	.07 – .07¼	.07½ – .08
Sulphur, crude	ton	20.00 –22.00	... – ...
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	... – ...	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	... – ...	2.00 – 2.75
Tin bichloride, 50 per cent	lb.	.18 – .19	... – ...
Tin oxide	lb.	... – ...	.40 – .42
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.11 – .11¼	.11½ – .12
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.12 – .13	.13½ – .14
Zinc oxide, XX	lb.	.08½ – .09	.09½ – .10
Zinc sulphate	lb.	.03¼ – .03½	.04 – .05

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities.

Alpha-naphthol, crude	lb.	$1.10 — $1.15
Alpha-naphthol, refined	lb.	1.25 — 1.30
Alpha-naphthylamine	lb.	.35 — .40
Aniline oil, drums extra	lb.	.21 — .26
Aniline salts	lb.	.26 — .29
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.00 — 1.50
Benzidine, base	lb.	.90 — .95
Benzidine sulphate	lb.	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .70
Benzoate of soda, U.S.P.	lb.	.65 — .70
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.28 — .30
Benzyl chloride, tech.	lb.	.20 — .25
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech.	lb.	.33 — .45
Beta-naphthylamine, sublimed	lb.	2.00 — 2.25
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .18
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.90 — .95
Cresylic acid, 95-97%, dark, in drums	gal.	.85 — .90
Cresylic acid, 50%, first quality, drums	gal.	.55 — .60
Dichlorbenzene	lb.	.07 — .08
Diethylaniline	lb.	1.20 — 1.25
Dimethylaniline	lb.	.45 — .55
Dinitrobenzene	lb.	.30 — .32
Dinitroclorbenzene	lb.	.20 — .30
Dinitronaphthalene	lb.	.30 — .40
Dinitrophenol	lb.	.35 — .40
Dinitrotoluene	lb.	.25 — .27
Dip oil, 25%, tar acids, car lots, in drums	gal.	.40 — .45
Diphenylamine	lb.	.60 — .70
H-acid	lb.	1.30 — 1.50
Meta-phenylenediamine	lb.	1.20 — 1.25
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.75 — 1.85
Naphthalene crushed, in bbls. (250 lb.)	lb.	.08 — .08½
Naphthalene, flake	lb.	.08½ — .09½
Naphthalene, balls	lb.	.09½ — .10½
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.16 — .18
Ortho-amidophenol	lb.	3.15 — 3.40
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.75 — .80
Ortho-nitro-toluene	lb.	.17 — .20
Ortho-toluidine	lb.	.20 — .25
Para-amidophenol, base	lb.	1.60 — 1.75
Para-amidophenol, HCl	lb.	1.75 — 1.85
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.85 — 1.05
Para-nitrotoluene	lb.	.85 — 1.00
Para-phenylenediamine	lb.	1.95 — 2.00
Para-toluidine	lb.	1.25 — 1.60
Phthalic anhydride	lb.	.50 — .60
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.11 — .13
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.75 — 1.85
Resorcinol, pure	lb.	2.25 — 2.30
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.22 — .23
Salicylic acid, U. S. P.	lb.	.21 — .22
Salol	lb.	.85 — .95
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.30 — .35
Tolidine	lb.	1.35 — 1.45
Toluidine, mixed	lb.	.40 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.42 — .45
Xylene, pure, in tank cars	gal.	.45 — ...
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.23 — $0.25
Beeswax, refined, light	lb.	.25 — .27
Beeswax, white pure	lb.	.45 — .47
Carnauba, Flora	lb.	.60 — .61
Carnauba, No. 2, North Country	lb.	.28 — .30
Carnauba, No. 3, North Country	lb.	.17 — .18
Japan	lb.	.18 — .16½
Montan, crude	lb.	.07 — .08
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 — ....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.03 — ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ — .04
Paraffine waxes, refined, 125 m.p.	lb.	.04 — .04¼
Paraffine waxes, refined, 128-130 m.p.	lb.	.04½ — .05
Paraffine waxes, refined, 133-135 m.p.	lb.	.06 — .06
Paraffine waxes, refined, 135-137 m.p.	lb.	.06½ — .06¾
Stearic acid, single pressed	lb.	.09½ — ....
Stearic acid, double pressed	lb.	.10 — ....
Stearic acid, triple pressed	lb.	.11 — .11¼

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.50 —	....
Rosin E-I	280 lb.	6.30 —	6.40
Rosin K-N	280 lb.	6.50 —	6.70
Rosin W. G.-W. W.	280 lb.	6.80 —	....
Wood rosin, bbl.	280 lb.	6.25 —	....
Spirits of turpentine	gal.	.82 —	....
Wood turpentine steam dist.	gal.	.80 —	....
Wood turpentine, dest. dist.	gal.	.78 —	....
Pine tar pitch, bbl.	200 lb.	..... —	7.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl.	500 lb.	—	12.50
Rosin oil, first run	gal.	.40 —	....
Rosin oil, second run	gal.	.44 —	....
Rosin oil, third run	gal.	.47 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.80
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	.39
68-70 deg., steel bbls. (85 lb.)	gal.	.38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30

Crude Rubber

Para—Upriver fine	lb.	$0.17 —	.17½
Upriver coarse	lb.	.11½ —	.11¾
Upriver caucho ball	lb.	.14 —	.14¼
Plantation—First latex crepe	lb.	.19 —	....
Ribbed smoked sheets	lb.	.17½ —	.18
Brown crepe, thin, clean	lb.	.15 —	....
Amber crepe No. 1	lb.	.17 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.09 —	$0.09½
Castor oil, AA, in bbls.	lb.	.10 —	.10¼
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.08¾ —	.09
Cocoanut oil, Ceylon grade, in bbls.	lb.	.10 —	.10
Cocoanut oil, Cochin grade, in bbls.	lb.	.10¾ —	.11
Corn oil, crude, in bbls.	lb.	.07 —	....
Cottonseed oil, crude (f. o. b. mill)	lb.	.05 —	.05¼
Cottonseed oil, summer yellow	lb.	.07¼ —	.07½
Cottonseed oil, winter yellow	lb.	.07½ —	....
Linseed oil, raw, car lots (domestic)	gal.	.60 —	.61
Linseed oil, raw, tank cars (domestic)	gal.	.53 —	....
Linseed oil, in 5-bbl lots (domestic)	gal.	.63 —	.65

Olive oil, Denatured	gal.	$1.35 —	$1.50
Palm, Lagos	lb.	.06¾ —	.07
Palm, Niger	lb.	.05¾ —	.06
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.05½ —	.06
Peanut oil, refined, in bbls	lb.	.10½ —	.10¾
Rapeseed oil, refined in bbls	gal.	.86 —	.88
Rapeseed oil, blown, in bbls	gal.	.92 —	.94
Soya bean oil (Manchurian), in bbls, N. Y.	lb.	.07¼ —	.07½
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.04¼ —	....
FISH			
Light pressed menhaden	gal.	$0.42 —	$0.43
Yellow bleached menhaden	gal.	.45 —	....
White bleached menhaden	gal.	.48 —	....
Blown menhaden	gal.	.80 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	25.00
Barytes, crude, 88% @ 94% ba., Kings Creek	net ton	10.00 —	1 .00
Barytes, floated, f.o.b. St. Louis	net ton	26.50 —	28.00
Barytes, crude, first grade, Missouri	net ton	10.00 —	....
Blanc fixe, dry	lb.	.05 —	.05½
Blanc fixe, pulp	net ton	50.00 —	60.00
Casein	lb.	.14 —	.16
Chalk, domestic, extra light	lb.	.05 —	.05½
Chalk, domestic, light	lb.	.04½ —	.05
Chalk, domestic, heavy	lb.	.04 —	.05
Chalk, English, extra light	lb.	.05 —	.07
Chalk, English, light	lb.	.05 —	.06
Chalk, English, dense	lb.	.04½ —	.05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00 —	10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00 —	15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00 —	22.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00 —	40.00
China clay (kaolin), imported, lump	net ton	23.00 —	25.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00 —	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00 —	25.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	24.00 —	27.00
Graphite, Ceylon lump, first quality	lb.	.07½ —	.08
Graphite, Ceylon chip	lb.	.06 —	.06½
Graphite, high grade amorphous crude	lb.	.02¾ —	.03
Pumice stone, imported, lump	lb.	.04 —	.50
Pumice stone, domestic lump	lb.	.05 —	.05½
Pumice stone, ground	lb.	.06 —	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	.... —	10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	.... —	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.... —	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.57 —	....
Shellac, orange superfine	lb.	.60 —	....
Shellac, A. C. garnet	lb.	.46 —	....
Shellac, T. N.	lb.	.50 —	....
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	14.00 —	15.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00 —	20.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50 —	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00 —	14.00
Talc, imported	ton	35.00 —	40.00
Talc, California talcum powder grade	ton	18.00 —	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	1,000		160
Carborundum refractory brick, 9-in.	less than carlot	1,000	1250.00
	carload lots	1,000	1100.00
Chrome brick, f.o.b. Eastern shipping points	net ton		80–100
Chrome cement, 40–45% Cr_2O_3	net ton		45– 50
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	....	55
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		55– 60
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		45– 50
Magnesite brick, 9-in. straight	net ton		90
Magnesite brick, 9-in. arches, wedges and keys	net ton		105
Magnesite brick, soaps and splits	net ton		120
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000		45– 55
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000		45– 55
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000		45– 55

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.15 —	.16
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.16 —	.17
Ferromanganese, 76–80% Mn, domestic	gross ton	85.00 —	90.00
Ferromanganese, 76–80% Mn, English	gross ton	85.00 —	90.00
Spiegeleisen, 18–22% Mn	gross ton	32.00 —	35.00
Ferromolybdenum, 50–60% Mo, per lb. of Mo	lb.	2.50 —	....
Ferrosilicon, 10–15%	gross ton	50.00 —	55.00
Ferrosilicon, 50%	gross ton	80.00 —	85.00
Ferrosilicon, 75%	gross ton	145.00 —	150.00
Ferrotungsten, 70–80%, per lb. of contained W	lb.	.45 —	.50
Ferrouranium, 35–50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30–40% per lb. of contained V.	lb.	5.00 —	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	45 —	50
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	45 —	50
Coke, foundry, f.o.b. ovens	net ton	4.50 —	5.00
Coke, furnace, f.o.b. ovens	net ton	3.25 —	3.75
Coke, petroleum, refinery, Atlantic seaboard	net ton	15.00 —	16.00
Fluor-spar, lump, f.o.b. Hea hoen, New Mexico	net ton	17.50 —	....
Fluor-spar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	20.00 —	22.50
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01¼ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.25 —	.30
Manganese ore, chemical (MnO_2)	gross ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55 —	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.14 —	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.14 —	.14
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.12 —	.13
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.50 —	....
Zircon, washed, iron free	lb.	.03 —	....

Non-Ferrous Metals

New York Markets

	Cents per Lb
Copper, electrolytic	12.625
Aluminum, 98 to 99 per cent	28.00@28.5
Antimony, wholesale lots, Chinese and Japanese	5¼@5½
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, spot and blocks	0.35
Monel metal ingots	0.38
Monel metal, shee bars	0.40
Tin, 5-ton lots, Straits	32.00
Lead, New York, spot	4.85
Lead, E. St. Louis, spot	4.65@4.75
Zinc, spot, New York	5.45
Zinc, spot, E. St. Louis	4.95

OTHER METALS

Silver (commercial)	oz.	$.60
Cadmium	lb.	1.00–1.10
Bismuth (500 lb. lots)	lb.	1.50@1.65
Cobalt	lb.	4.00
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	72.00–75.00
Iridium	oz.	250.00@300.00
Palladium	oz.	65.00@70.00
Mercury	75 lb.	45.00–46.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.50–20.75
Copper bottoms	28.00–28.25
Copper rods	19.25–20.00
High brass wire	18.25
High brass rods	15.25
Low brass wire	20.25
Low brass rods	20.25
Brazed brass tubing	29.00
Brazed bronze tubing	34.25
Seamless copper tubing	22.00
Seamless high brass tubing	21.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York				
	Current	One Year Ago		Cleveland	Chicago
Copper, heavy and crucible	8.50@ 9.00	18.50		10.00	10.50
Copper, heavy and wire	8.00@ 8.25	16.50		9.50	9.50
Copper, light and bottoms	7.00@ 7.50	14.50		9.00	8.50
Lead, heavy	3.25@ 3.50	7.25		4.00	4.00
Lead, tea	2.15@ 2.30	5.25		3.00	3.00
Brass, heavy	4.25@ 4.50	9.50		7.00	10.00
Brass, light	3.00@ 3.25	8.00		5.00	5.50
No. 1 yellow brass turnings	4.00@ 4.25	9.50		5.50	6.00
Zinc	2.00@ 2.50	5.00		3.00	3.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.50	$3.23	$3.23
Soft steel bars	2.50	3.00	3.13
Soft steel bar shapes	2.50	3.13	3.13
Soft steel bands	2.85	3.83	3.78
Plates, ¼ to 1 in. thick	2.50	3.30	3.23

*Add 10c per 100 lb. for trucking to Jersey City and 15c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

FORT SMITH.—The Fording Refinery Co., recently organized with a capital of $250,000, has acquired property at Van Buren, Ark., comprising about 17 acres of land, as a site for the erection of a new oil refinery with initial daily capacity of about 500 bbl. A plant for the extraction of gasoline will also be constructed. E. F. Blanchard is president, and John H. Vaughn, secretary.

Alabama

ANNISTON—The Anniston Electric Steel Co., recently organized, is considering the erection of a number of additions to the plant of the Anniston Steel Works, which it has acquired for the manufacture of electric steel products. The company will make a specialty of electric steel castings, gray iron and other castings. G. C. Illingworth is vice-president and general manager.

BIRMINGHAM—The Johnson-Thompson Foundry Co., North 26th St., is planning for the erection of an addition to cost about $22,000.

California

LOS ANGELES—The Co-Operative Glass Co., Bank of Italy Bldg., has filed plans for the erection of a new plant at 751 South Daly St., to comprise mold shop, 40 x 75 ft., and main glass manufacturing works, 90 x 180 ft. The Pozzo Construction Co., 421 Macy St., has the building contract.

DOWNEY—The West Coast Asbestos Co. is planning for the erection of a number of new buildings at its local plant. Equipment will be installed to double the present capacity.

Delaware

WILMINGTON—The Atlas Powder Co., du Pont Bldg., is planning for the erection of a new plant for the manufacture of carbon products, to be operated by its subsidiary organization, the Darco Corp. The new plant will have an initial output of 6,000 tons, and will include refining works and other departments.

Georgia

MACON—The Buckeye Cotton Oil Co. is reported to be planning for the rebuilding of its local plant, recently destroyed by fire with loss estimated at about $135,000, including machinery.

ATLANTA—The Diamond Holdfast Rubber Co., 33 Auburn Ave., has acquired property totaling about 11 acres, as a site for the erection of a new plant for the manufacture of rubber products, including rubber cement and adhesive rubber compounds. The works will comprise a group of buildings, with main 2-story structure.

Indiana

DUNKIRK—The Indiana Glass Co. has awarded a contract to the Austin Co., Euclid Ave., Cleveland, O., for the erection of a new 1-story manufacturing plant, 60 x 100 ft.

JEFFERSONVILLE—Colgate & Co., 105 Hudson St., Jersey City, N. J., manufacturer of soaps and kindred products, has acquired the Indiana Reformatory property at Jeffersonville, from the state, for the establishment of a new branch plant. The company will take possession of the property within a few months and will remodel the different structures and install necessary machinery. The works will specialize in the manufacture of soap products, washing powders and cleansing compounds. It is expected to give employment to about 1,000 operatives for initial operatives.

Louisiana

SHREVEPORT—The United States Window Glass Co., Morgantown, W. Va., is perfecting plans for the erection of its proposed new plant at Shreveport, to consist of a number of 1- and 2-story buildings, estimated to cost in excess of $2,000,000 with machinery. The company is operating a plant at Morgantown, and was recently incorporated with a capital of $4,000,000. Walter A. Jones is president. The DeVore Co., 908 Nicholas Bldg., Toledo, O., is architect and engineer for the new Shreveport plant.

Maryland

BALTIMORE—The United States Industrial Alcohol Co. is having plans prepared for the erection of a 1-story addition to its plant in the Curtis Bay section, 60 x 180 ft. The company has recently filed plans for another building at the plant to cost about $18,000.

FROSTBURG—Fire, April 22, caused by an explosion, destroyed a portion of the works of the Big Savage Fire Brick Co., with loss estimated at about $25,000.

MOUNT SAVAGE—The Mount Savage Fire Brick Co. has awarded a contract for the erection of an addition to its plant to Golin Gerlach, Frostburg, Md. A power plant will also be constructed.

Minnesota

MINNEAPOLIS—The Minnesota Mfg. Co., 722 North 3d St., manufacturer of sweeping compounds and other chemical products, is having plans prepared for the erection of a 2-story and basement plant, 16 x 132 ft., on Eighth St., near Third St. Perry Crosier, 915 New York Life Bldg., is architect.

Missouri

ST. LOUIS—The Herman Oak Leather Co., 4030 North Main St., is taking bids for the erection of a 2-story and basement plant addition, 25 x 70 ft., to cost about $22,000. L. C. Herman is head.

KANSAS CITY—The Standard Steel Works, 1722 Tracy St., will break ground at once for the erection of a new 2-story addition 25 x 115 ft., at North Kansas City, to cost in excess of $55,000. Contract for erection recently was awarded to Fred Crites, 2136 Belleview Ave.

New Jersey

CAMDEN—The Camden Coke Co. is arranging for the installation of a new battery of coke ovens. The company is a subsidiary of the Public Service Corporation, Newark, N. J., which has secured permission from the Board of Public Utility Commissioners to issue notes for $1,496,000 to defray the cost of the work.

NEWARK—The Celluloid Co., 290 Ferry St., is having plans drawn for the erection of an addition to its plant. Alterations and improvements will also be made in existing buildings at the plant.

NEW BRUNSWICK—Johnson & Johnson, manufacturers of chemicals, drugs, etc., will dispose of a portion of their local plant, consisting of a 2-, 3- and 5-story building, totaling about 122,215 sq.ft. in area.

NEWARK—The American Pipe & Bending Co. has taken bids for the erection of a new 1-story plant on Coit Street, 60 x 120 ft., to cost about $20,000. Strombach & Mertens, 1091 Clinton Ave., are architects.

New York

BROOKLYN — The Burley Welding Works, 22-24 Kosciusko St., is taking bids for the erection of a new 3-story plant, 40 x 100 ft., to cost about $50,000. Edward M. Adelsohn, 1778 Pitkin Ave., Brooklyn, is architect.

Oklahoma

SAND SPRINGS—The Oklahoma Tanning & Mfg. Co., Tulsa, has acquired property at Sand Springs, totaling about 5 acres, for the erection of a new leather tannery. The initial works will cost about $45,000. Uley Holderman is president.

Pennsylvania

ERIE—The Keystone Rubber Co., 11th St., is reported to be planning for the rebuilding of its plant, destroyed by fire, April 28, with loss estimated at about $500,000, including machinery. The fire was caused by an explosion of chemicals.

AMBRIDGE—The Columbia Steel & Shafting Co., Carnegie, Pa., has completed plans for the erection of its proposed new plant at Ambridge, to consist of a group of 1-story buildings, estimated to cost about $3,000,000 with machinery. Hopkinson & Schaeffer, 500 Marion Bldg., Cleveland, O., are architects.

Tennessee

CHATTANOOGA—The Signal Mountain Cement Co., 1022 James Bldg., will soon take bids for the erection of a new local plant for the manufacture of cement, estimated to cost in excess of $200,000. A. F. Miller, 205 James Bldg., is engineer.

Texas

BURNET—The Sulphus Oil Co. is planning for the development of ichthyol properties in this section. The company has extensive deposits and it is said that so far as is known at the present time, the material is not found in any other place in this country. A refining plant is proposed for the production of ammonium ichthyolate from the raw material.

COMMERCE—The Trinity Paper Mills, Dallas, Tex., is completing plans for the erection of its proposed new paper mill at Commerce, to have an initial capacity of 50 tons. The plant will specialize in the manufacture of writing papers, tissue, blotting and other papers. George W. Lull is president.

THREE RIVERS—The Three Rivers Glass Co., recently organized, is perfecting plans for the erection of its proposed new local plant for the manufacture of flint glass bottles. The initial plant unit will cost about $30,000, and is expected to be ready for occupancy in the fall. It will be supplemented by other plant buildings at an early date. John Finkbeiner is manager.

Virginia

ROCKY MOUNT—The Vicama Mica Co. Inc., Hagerstown, Md., recently incorporated, is planning for the operation of mica properties in this section, as well as in North Carolina. The company will also produce feldspar and kindred products. Considerable equipment will be acquired for operations. John W. and J. R. Feldman, 3 Hamilton Row, Hagerstown, head the company.

RICHMOND—The Pioneer Products Co., recently incorporated with a capital of $1,000,000, will operate a local plant for the manufacture of rubber products. H. C. Wilder, Malone, N. Y., is president, and W. C. Faulkner, Richmond, secretary.

West Virginia

HUNTINGTON—The Lambie Chemical Co. is arranging for increased production at its local plant, advancing to about 50 per cent of normal output. The company has recently been engaging at about one-half of this capacity. The working force will be increased by about 40 men, and particular attention given to color production. It is planned to develop the plant to its maximum in this latter line early in the fall. R. D. Lambie is president.

SCOTT DEPOT—The Di Bella Glass Co., recently organized, will operate a local plant for the manufacture of glass products. The company is headed by H. H. Pine and E. A. Taylor, Scott Depot; and G. T. Pine, Charleston, W. Va.

Wisconsin

MILWAUKEE — The Western Metal Specialty Co., 1919 St. Paul Ave., is completing plans for the erection of an addition to its plant to cost about $40,000.

BLACK CREEK—The Outagamie Limestone Co., 75 30th St., Milwaukee, has plans under way for the construction of a new limestone working plant in the vicinity of Black Creek, estimated to cost about $200,000, with machinery. F. A. Mass is head.

New Companies

THE COROGO TANNING CO., Lynn, Mass., has been incorporated with a capital of $50,000 to manufacture leather products. The incorporators are Saul L. Cohen and William J. Rose, Boston.

THE PAEPECKE PAPER MILLS CO., 111 Washington St., Chicago, Ill., has been incorporated with a capital of $50,000 to manufacture paper goods. The incorporators are Walter P. Paepcke, R. L. McClelland and E. A. Lang.

THE CLEANING COMPOUNDS MFG. CO., New York, has been incorporated with a capital of $25,000 to manufacture chemical compounds and kindred products. The incor-

I. White and T. N. Ripsom, 366 Madison Ave.

THE MINERALS REDUCTION CORP. OF AMERICA, Berwick, Me., has been incorporated with a capital of $10,000,000 to operate reduction works for the manufacture of mineral and metal products. Thomas I. Hogan is president; Ralph W. Goss is treasurer.

THE MICA CO. OF CANADA, INC., St. Regis Falls, N. Y., has been incorporated with a capital of $150,000 to manufacture mica products. The incorporators are O. H. Smith, C. J. Toohey and R. A. Reid. The company is represented by H. A. Ross, Montreal.

THE EMPIRE LABORATORIES, INC., West New York, N. J., has been incorporated with a capital of $200,000, to manufacture chemicals and chemical byproducts. The incorporators are Jacob J. Storz, Frederick K. Lane and M. F. Curry, 595 Jefferson St.

THE ENO RUBBER CORP., Los Angeles, Cal., has been incorporated with a capital of $20,000 to manufacture rubber goods. The incorporators are Roy R. Musser, George W. Eno and William M. Morse. William Morse, Jr., California Bldg., represents the company.

THE CENTRAL ILLINOIS PETROLEUM CO., 1703 B'way., Mattoon, Ill., has been incorporated with a capital of $200,000 to manufacture petroleum products. The incorporators are Daniel S. Campbell, Thomas M. Stanbury and William D. Jones.

THE ESSENTIAL MATERIALS CO., New York, has been incorporated with a capital of $100,000 tc manufacture dyes, chemicals and affiliated products. The incorporators are G. Lau, L. H. Wallace and F. T. Commoss. P. H. Delehanty, 115 B'way., represents the company.

THE NATIONAL REFRACTORIES CORP., New York, has been incorporated with a capital of $20,000 to manufacture refractory products. The incorporators are J. M. Devlin, A. M. Klupt and W. Bruchhausen. Duncan & Campbell, 189 Montague St., Brooklyn, N. Y., represent the company.

THE ATLAS DIE-CASTING CO., INC., Worcester, Mass., has been incorporated with a capital of $200,000 to manufacture die-castings and other metal products. The incorporators are Arthur M. Brewster, Allan Robinson and Malcolm F. MacNeil, 25 Brighton Ave., Boston, Mass.

THE KING-CRAIG OIL CO., Los Angeles, Cal., has been incorporated with a capital of $500,000 to manufacture petroleum products. The incorporators are John J. Craig, Los Angeles; James W. Reagan, Long Beach, Cal.; and Everett H. King, Inglewood, Cal.

THE WOODSIDE COLOR CORP., New York, has been incorporated with a capital of $50,000 to manufacture chemicals, colors, dyes and kindred products. The incorporators are C. S. L. Tuynman, W. D. P. Evans and B. L. Blauvelt, 99 Nassau St.

THE JUMBO TILE WORKS, INC., Goldsmith, Ind., has been incorporated with a capital of $50,000 to manufacture clay tile, bricks and other burned clay products. The incorporators are E. A. Teter, W. A. Parks and J. N. Russell, Goldsmith.

THE RAVENSWOOD PORCELAIN & GLASS CO., Ravenswood, W. V., has been incorporated with a capital of $500,000 to manufacture glass, porcelain and other ceramic products. The incorporators are J. H. Camp and J. W. Hall, Ravenswood.

THE ADAMS OIL & COMPOUND CO., 549 West Washington St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture compounds, chemicals, oils, etc. The incorporators are Harry R. Adams, Philip R. Monson and Mont C. Adams.

THE BEAVER RUBBER MFG. CO., New York, has been incorporated with a capital of $250,000 to manufacture rubber products. The incorporators are F. L. Minnigerode, C. M. Coryell and W. P. Kown, 50 Church St.

THE MARYLAND INDUSTRIAL ALCOHOL CO., Baltimore, Md., has been incorporated with a capital of $700,000 to manufacture industrial alcohol products and other kindred specialties. The incorporators are Edward H. Hammond, R. Bennett Darnall and Harry E. Karr, Fidelity Bldg.

THE WESTERN SEABOARD OIL CO., Los Angeles, Cal., has been incorporated with a capital of $300,000 to manufacture petroleum products. The incorporators are J. W. Lonn, W. S. McKee and W. C. Bramham, Los Angeles.

THE AREX PRODUCTS CORP., New York has been incorporated with a capital of $7,750,000 to manufacture chemical products. The company is represented by Arthur W. Britton, 65 Cedar St., New York.

THE STARR CHEMICAL LABORATORIES, 16 Lewis St., Newark, N. J., has filed notice of organization to manufacture chemicals and chemical byproducts. Jacob Starr, 347 South 11th St., heads the company.

HULL & HULL, INC., Tampa, Fla., has been incorporated with a capital of $50,000 to manufacture burned clay products. A. G. Runyon is president; Randell Bell, secretary-treasurer, both of Pensacola, Fla.

THE CARPENTIER CHEMICALS, INC., 175 West Jackson Blvd., Chicago, Ill., has been incorporated with a capital of $10,000 to manufacture chemicals and chemical byproducts. The incorporators are O. T. Carpentier, Edward J. Hess and M. G. Eckersberg.

THE FEDERAL CHEMICAL CO., Nitro, W. Va., has been incorporated with a capital of $250,000 to manufacture chemicals and chemical byproducts. The incorporators are John V. Ray, C. P. Miller and W. D. Payne, all of Charleston, W. Va.

THE NATIONAL ZINC CORP., New York, has been incorporated with a capital of $300,000 to manufacture zinc and other metal products. Morris Stein, 945 Aldus St., is the principal incorporator.

THE KERO CHEMICAL CORP., Bay Shore, L. I., has been incorporated with a capital of $300,000 to manufacture chemicals and chemical byproducts. The incorporators are C. Young, C. V. Reeve and H. W. Barto. F. J. Knorr, Albany, N. Y., represents the company.

THE L. V. S. SOAP CO., Gloucester, N. J., has been incorporated with a capital of $125,000 to manufacture soap and kindred products. The incorporators are George Link, William J. Van Meter, Gloucester; and Spencer Simpson, Camden.

THE CHAMPLAIN VALLEY OIL CO., Plattsburg, N. Y., has been incorporated with a capital of $50,000 to manufacture oils. The incorporators are O. L. Trembly, G. P. and R. A. Sharron, and B. F. Feinberg, Plattsburg.

THE RENFRO-JUSTUS PAINT CO., Brownwood, Tex., has been incorporated with a capital of $10,000 to manufacture paints, oils, etc. The incorporators are J. F. Renfro, C. B. Justus and O. J. McInnis.

THE HANOVER BRICK MFG. CO., Morristown, N. J., has been incorporated with a capital of $100,000 to manufacture bricks, with plant at Whippany, near Morristown. The incorporators are Richard W. and Jesse L. McEwan, and Charles W. Ennis, 3 Elm St.

THE CALIFORNIA PAINT & SHELLAC CO., Los Angeles, Cal., has been incorporated with a capital of $20,000 to manufacture paint, shellac and kindred products. The incorporators are C. M. Berry, J. H. Weaver and G. S. Hinson. The company is represented by Alfred Barstow, 600 Kerckhoff Bldg.

THE BOVING MFG. CO., 111 East State St., Trenton, N. J., has been incorporated with a capital of $100,000 to manufacture tiles and other ceramic products. The incorporators are Christian O. Osterberg, Paul C. Boving and Charles J. Falcey, Trenton.

THE QUINLEY MAGNESIA CO., Cortland, O., with an authorized capital of $100,000 of 8 per cent cumulative preferred stock and 2,000 shares of no par value common stock, has been incorporated, with J. C. Quinley, L. A. Kirtland and others as incorporators. The company will erect a plant on the Erie R.R. at Cortland for the manufacture of asbestos and magnesium products. An initial daily output of 4,000 lb. of magnesium carbonate is expected by July 1 from the first unit. The product manufactured will be largely for drug and rubber trades and for locomotive lighting, pipe covering, et cetera.

THE MARVELLUM CO., Holyoke, Mass., has been incorporated under the laws of Massachusetts with a capital of $165,000 and has leased manufacturing space in the Holyoke Valve and Hydrant Bldg. It will start manufacturing a line of specialty cover papers according to a new coloring process. The officers are George Senseney, F. C. Haywood and Russell Bracewell.

The B. & M. Oil Co., Los Angeles, Cal., has been incorporated with a capital of $500,000 to manufacture petroleum products. The incorporators are J. M. Brown, Long Beach, Cal.; F. N. Crippen, Pasadena, Cal.; and S. E. Meserve, 417 Union Oil Building, Los Angeles.

The Carbonite Mfg. Co., 324 Stephen Street, Belleville, N. J., has filed notice of organization to manufacture carbon specialties. William H. Moulton heads the company.

Capital Increases, Etc.

THE EASTMAN SALT PRODUCTS CO., Saginaw, Mich., has filed notice of change of name to the Saginaw Salt Products Co.

THE MONONGAH GLASS CO., Fairmont, W. Va., is arranging for an increase in capital from $1,000,000 to $2,500,000. R. T. Cunningham is secretary.

THE HARNER OIL & REFINING CO., St. Paul, Minn., a Delaware corporation, has filed notice of change of name to the Harner Oil Refining & Mining Co., at the same time increasing its capital from $2,000,000 to $10,000,000.

THE UNITED ALLOY STEEL CORP., 165 B'way., New York, has filed notice of change in capital to an active amount of $9,525,000, and preferred stock to the value of $3,300,000. The company recently took over the United Furnace Co., and the Berger Mfg. Co., Canton, O.

THE INDEPENDENT OIL CO., Decatur, Ill., has filed notice of increase in capital to $50,000.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN IRON AND STEEL INSTITUTE will hold its nineteenth general meeting in the Hotel Commodore, New York, on Friday, May 27. There will be three sessions: A forenoon session beginning at 10 o'clock daylight saving time (9 a.m. eastern time); an afternoon session at 2; and a banquet in the evening at 7.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its eighteenth annual meeting at the Hotel Ambassador, Atlantic City, June 9, 10 and 11.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN OIL CHEMISTS' SOCIETY (formerly the Society of Cotton Products Analysts) will hold its twelfth annual meeting in Chicago May 16 to 17. Headquarters will be at the Congress Hotel.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting at the Congress Hotel, Chicago, May 23 to 26.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12, in the Eighth Coast Artillery Armory, New York City.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-eighth annual convention at the Greenbrier Hotel, White Sulphur Springs, W. Va., the week beginning June 20.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magaine from time to time.

STAMFORD CHEMICAL SOCIETY, Stamford Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month; except June, July, August and September.

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.